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(As a stimulant to your courage — if you need one—turn to page 66.)

F. C. Morrow

Editor.

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1—machine tool application; 2—on ventilating systems; 3—on Viscolizer; 4—on laundry machinery; 5—on spinning frames.

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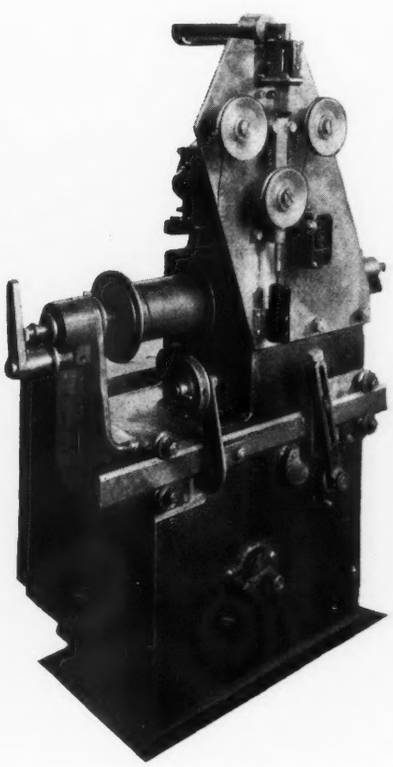
FEBRUARY, 1931

INDUSTRY *RUBS* ALADDIN'S LAMP

By G. A. VAN BRUNT
Electrical Editor

In "Industry *Finds* Aladdin's Lamp," April, 1930, the characteristics and some of the possibilities of electron tubes in industrial service were discussed. Here are a number of typical applications that industry has recently made.

ELECTRON tubes are largely associated, in the public mind, with their applications in the radio and talking picture fields, and with some of the spectacular tricks that have been performed with the "electric eye" or photo-electric cell. As a matter of fact, considerable progress has been made in applying them in one way or another to a variety of manufacturing processes. In these applications, which differ widely in purpose and operating conditions, the electron tube has shown itself to be an invaluable tool either for accomplishing some end that was hitherto unattainable, or in providing new and better means of performing operations that have previously been done in other ways.

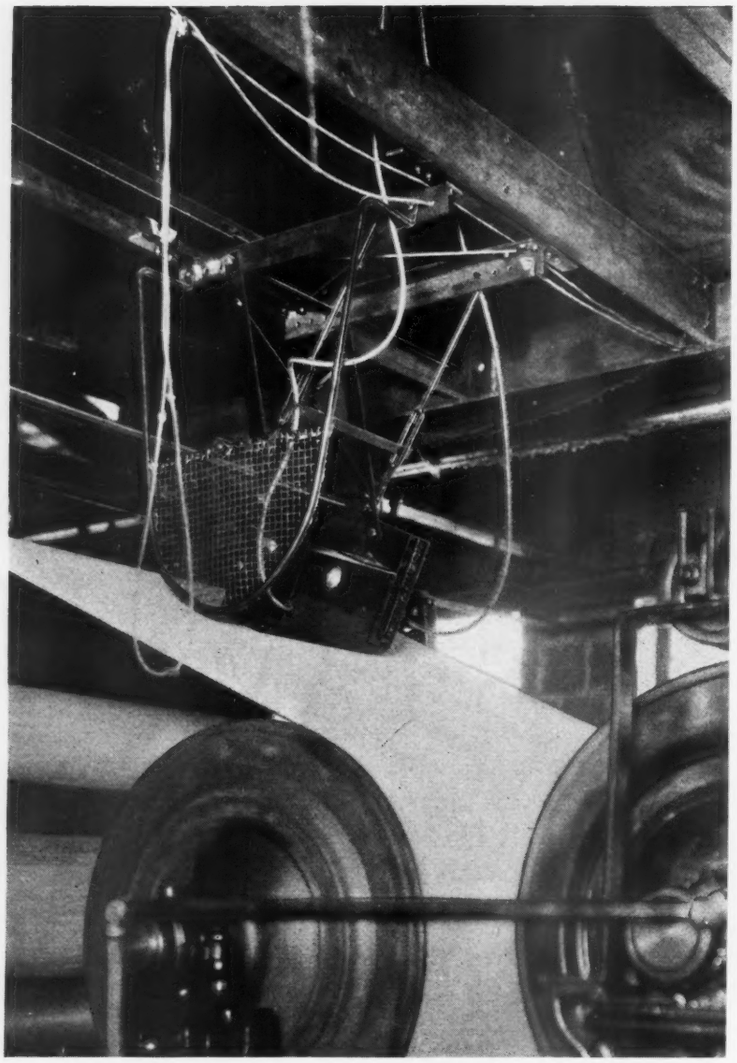


Electron tube control for winder of wire-drawing machine.

A considerable number of the industrial applications of electron tubes involve the use of the photo-electric cell. In such applications flashing of a beam of light into the photo-electric cell, interruption of the beam, or variations in its intensity, as the case may be, alter the amount of current flowing through the cell. This action in turn affects delicate relays that control heavier currents and actuate motors or other equipment required to produce the desired effect.

One interesting application of this type was recently installed in a large food products plant. A noteworthy feature of this installation is the fact that a photo-cell-controlled device is employed to check the accuracy of, and compensate for errors in, the operation of an automatic packaging machine.

One of the products of this plant is cereals which are packed in car-



Typical installation of electron tube equipment for indicating moisture content of paper as it comes from the machine.

tons protected by a sealed, waxed-paper envelope. The waxed wrapping paper is received, completely imprinted, in large rolls and is cut into the proper lengths by the automatic wrapping machines. However, these machines, which cut the waxed paper, wrap it around the cartons, and seal it, were not accurate enough to cut the paper off at the proper point for the printing. The best machines allowed a small amount of slip or creepage of the paper in passing through the feeding rolls, and the cumulative error resulted in packages with the design in various undesirable positions.

The problem was solved by the use of a photo-electric equipment actuated by variations in the intensity of a beam of light. A small spot is printed on the waxed paper in register with the design, and spaced at regular intervals. A concentrated beam of light shines through the waxed paper upon the photo-electric cell and as the paper moves along these printed spots cast shadows on the cell, causing it to send electric impulses that are amplified in order to operate power relays.

The paper feed rolls were originally driven by gears from the cutoff knife and were set to deliver a sheet of a certain length at every revolution of the knife. Where printed paper is used, however, it is necessary to vary slightly from time to time the amount of paper fed to the knife, in order to correct for the slippage of the rolls. To control this slippage a variable-speed drive, instead of the gears, was placed between the knife and the feed rolls. The variable-speed drive is controlled by the electric impulses from the photo-electric cell.

In operation, the photo-electric cell sends out an impulse at regular intervals and from time to time one or the other of two relays closes and the control lever of the variable-speed drive moves from the neutral position either to the right or to the left, and then returns to neutral. In addition, a set of signal lights in front of the operator shows that a correction is being made, and indicates the direction. The correction consists in speeding up or slowing the paper down slightly, depending on whether the knife is cutting the paper ahead of or behind the proper point.

The control apparatus now keeps the cut within $\frac{1}{16}$ in. of the correct point, the sheets of paper being all the length required for wrapping. It will operate at any wrapping machine speed, which is 72 packages per min. in the present instance.

Incidentally, the method of control worked out here was found to be generally applicable to automatic wrapping machines using a continuous method of paper feed, with a rotary knife and continuously moving paper feed rolls.

A recent investigation has shown that other industrial applications of photo-electric-cell equipment that are now in service, or being put in, cover a surprisingly wide range of operation. For example, photo-electric cells control the raising and lowering of fourteen massive soaking pit covers in one of the large steel mills. Fourteen photo-cells, one for each pit, are mounted on one of the walls. When the crane operator desires to remove an ingot from one of the soaking pits, it is necessary for him merely to throw a beam of light on the photo-cell controlling the cover on that pit. In this way the photo-electric cell is made to operate the control of the motor that raises and lowers the pit cover.

A paper bag manufacturer employs photo-electric cell equipment to accomplish about the same purpose as outlined earlier in this article. The paper, which comes in rolls, is fed into the bag machine at a speed of 800 f.p.m. A photo-electric cell "watches" the design printed on the paper and at precisely the proper time sends out an impulse that operates the shears which cuts the paper into the lengths required for the bags.

Substantially the same principle is used in cutting the cellophane wrappers for cigars, in the wrapping machine put out by one manufacturer.

One of the largest manufacturers of chewing gum employs photo-elec-

tric cell equipment for controlling the wrapping operation, and also for counting the packages.

Several concerns have installed smoke recorders or detectors. As was explained in a previous article in the April, 1930, issue, these devices consist essentially of a photo-electric cell mounted in one side of the stack, and a suitable light source placed in the opposite side. A beam of light is concentrated on the photo-electric cell. Any diminution of the intensity of the light beam, by the presence of smoke, causes a change in the current flow through the photo-cell, which can be registered by either an indicating or recording instrument.

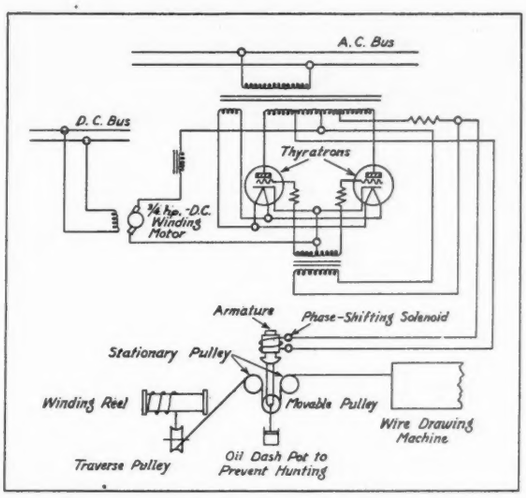
One of the well-known domestic refrigerator manufacturers is making use of photo-electric cell equipment for counting and sorting its product.

A number of lighting control units are in operation for turning on the lights in factories when the intensity of daylight illumination falls below a certain value, lighting electric signs, and so on.

In at least one large paper mill photo-electric cell equipment is employed to indicate breaks in the web or sheet coming from the paper machine.

One varnish manufacturer is using this type of equipment in checking the consistency of the product. A bleachery and the medical laboratory of a life insurance company are using photo-electric cell equipment to check or measure the turbidity of solutions, and one of the large oil companies employs it for checking the alkalinity of solutions used in some of the refining processes.

One company that makes railway signalling equipment uses photo-electric cells for calibrating the signal lamps. A manufacturer of incandescent lamps likewise uses these cells in the routine checking of lamps for emission of light. In the latter instance, substitution of the present method of testing for the one that was previously used has speeded up the inspection process considerably, and reduced it from a laboratory operation that required a skilled operator to a short and simple procedure that can readily be carried out by an unskilled but intelligent operator.

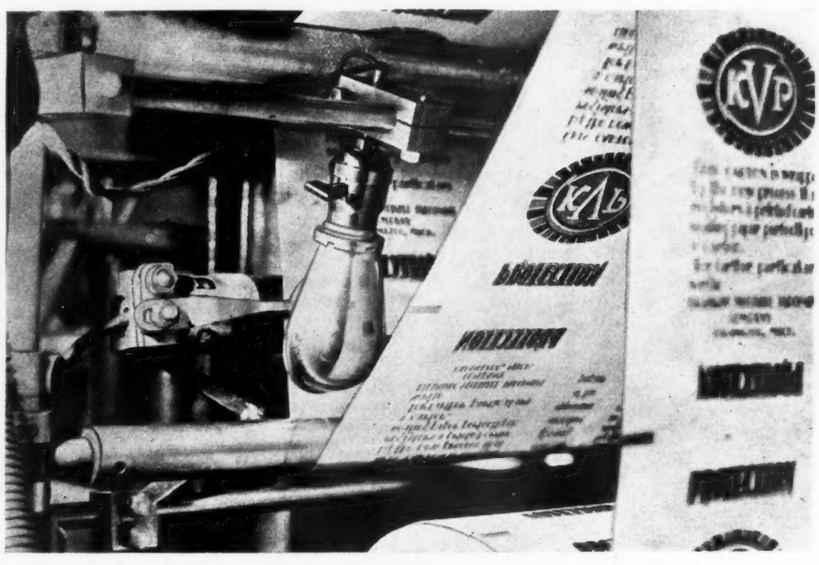


Connection diagram of tube control unit for regulating speed of winder on wire-drawing machine.

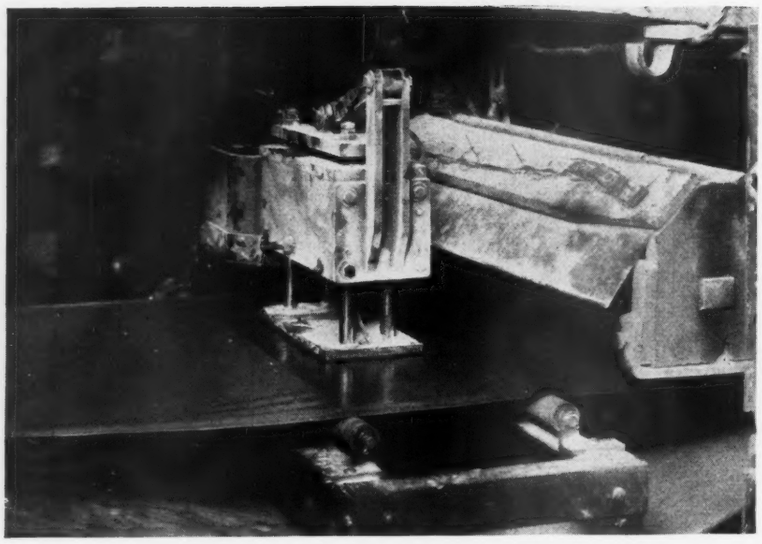
A manufacturer of radio tubes found in a photo-electric cell unit the solution of the very troublesome problem of keeping at a constant value the seventeen different voltages required at the test benches. The method now employed, which was described in detail in the December, 1930, issue of *Electronics*, could be applied to many processes in which the position of the needle of an indicating instrument will show a desired, or abnormal, condition.

Each testing bench was formerly equipped with a voltmeter and voltage control. These have now been eliminated and the seventeen voltages required are measured and controlled from a central control panel. The photo-electric cell is used in conjunction with a master monitoring meter and a commutating device by which this meter is connected in succession to each of the voltage circuits being supervised.

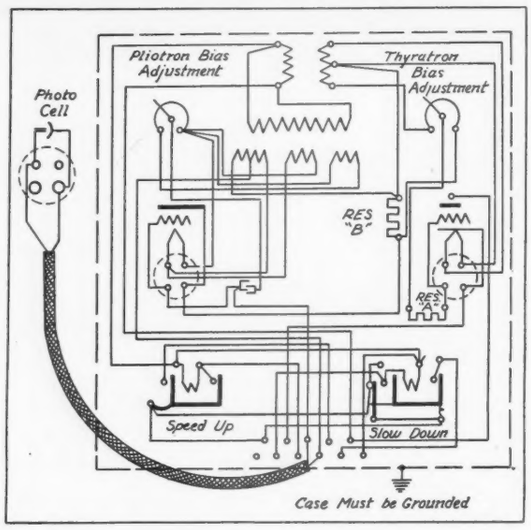
The monitoring meter is an 0-10 milliammeter which, by means of the proper series resistors, will read exactly 5 milliamp. whenever it is connected to any voltage circuit, providing that circuit is adjusted to its normal voltage. At exactly the 5 milliamp. point on the scale of the meter a small hole was drilled through the dial and another hole exactly in line with it was drilled through the case of the meter. In front of the meter is mounted a 22-candlepower lamp, with a lens for focusing the light rays on



A photo-electric cell is employed for the register control of this packaging machine. The lamp and reflector in the center form the light source. Note the register marks printed on the near edge of the paper.



Weight of gum stock in several rubber plants is controlled by passing it between the plates of a variable condenser in the circuit of a simple receiving set. Impulses from a sending station, which is part of the equipment, are picked up and registered on an indicating or recording instrument.



Wiring diagram of photo-electric cell control for wrapping machine.

the aperture, by means of a mirror.

The photo-electric cell is placed behind the meter and if the pointer stands at any value other than 5 milliamp. the rays from the lamp will pass through the hole in the meter scale and impinge on the photo-electric cell. However, if the pointer shows exactly 5 milliamp., it will obstruct the passage of the ray and the photo-electric cell will be dark.

Light shining on the photo-electric cell causes a normally-energized relay to drop, energizing a second relay which in turn operates a large pilot light and signal gong, and serves to disconnect the motor driving the commutating device. There are a number of small pilot lights, one for each circuit being supervised, that show the particular circuit with abnormal voltage.

The monitoring meter is connected in the proper sequence to each circuit for about three seconds in every 80 seconds. When the photo-electric cell alarm functions, the motor stops at that point and causes the pilot light corresponding to the circuit in trouble to stay lit until the voltage is corrected.

Maintaining a definite, uniform moisture content and weight or thickness of the product is of much importance in the paper and rubber industries, for example. To control these factors, a considerable number of mills in both of these industries are making use of an electron-tube device of radically different character from the light-sensitive equipment that has heretofore been considered. The equipment employed for weight or moisture control comprises a sending station that emits a wave whose length is sufficiently above the regular broadcasting band not to cause interference. The impulses are received on a simple receiving circuit containing a variable condenser and the necessary amplifying units.

The material whose thickness is to be controlled passes between the plates of the variable condenser. Minute changes in the thickness of the material, which forms the dielectric of the condenser, will alter the capacity and consequently the output of the receiving circuit, and can be registered on an indicating or recording instrument, as desired.

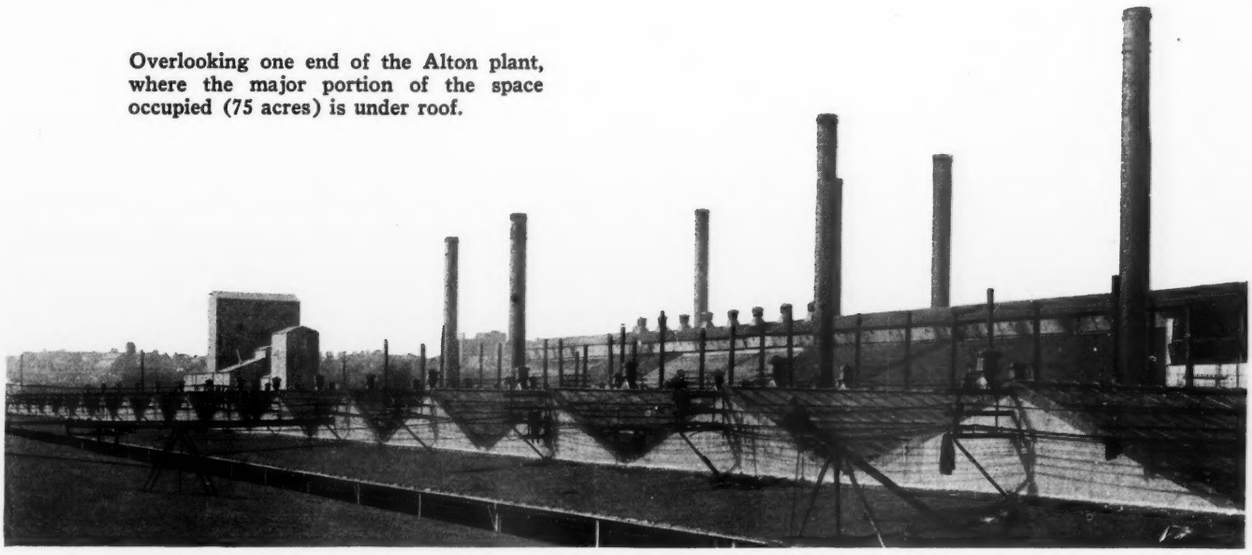
Accurate control of motor speeds is well illustrated by an installation in the wire-drawing plant of one of the large electrical manufacturers.

As it is drawn, the wire leaves the last block at practically constant speed and is reeled up. It is necessary that a certain tension be maintained on the wire while it is being reeled. Obviously, the speed of the reel must be gradually decreased as layer after layer of wire increases its diameter. The problem of maintaining the proper tension is especially troublesome with small wire, as the margin between the required tension and the breaking stress is not very great.

A satisfactory speed control for the motor driving the reel was eventually worked out through the use of two electron tubes that are very similar in operation to mercury arc rectifiers. After leaving the last block, the wire passes under a floating pulley mounted between two stationary guide pulleys. An adjusting lever enables the tension on the wire to be set at any desired value. Up or down movement of the floating pulley causes a corresponding movement of the armature of a small solenoid, thereby changing the inductance of the grid circuit of the tubes. With such changes in inductance, the output voltage of the tubes is raised or lowered, thus changing the voltage impressed on the armature of the reel-driving motor. Movement of the solenoid plunger within a range of 2 in. will control the speed of the motor from standstill to full speed.

At the present time electron-tube equipment is commercially available for armature current control of motors up to 5-hp. rating at 230 volts. Larger motors can be handled if field control is used.

These are a few typical examples of several hundreds of installations of electron-tube equipment that are in use. In addition, a large amount of experimental work is being conducted, and it is safe to assume that out of these investigations there will come many new and important applications.



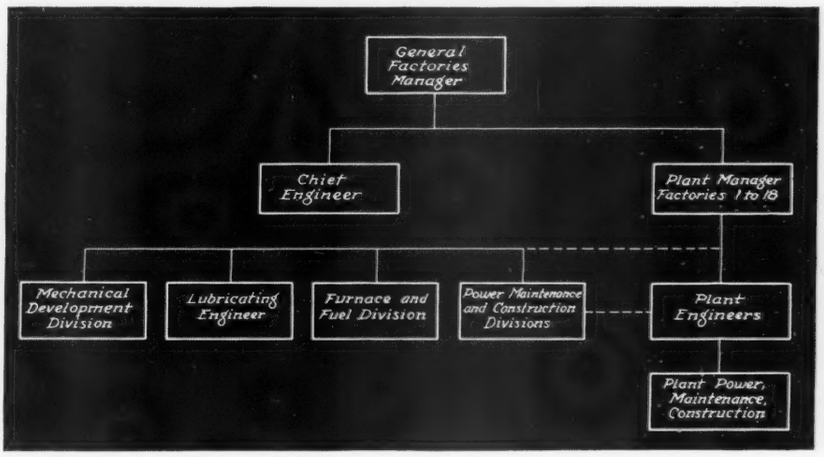
Overlooking one end of the Alton plant, where the major portion of the space occupied (75 acres) is under roof.

How Plant Engineering Is Co-ordinated in Our Eighteen Branches

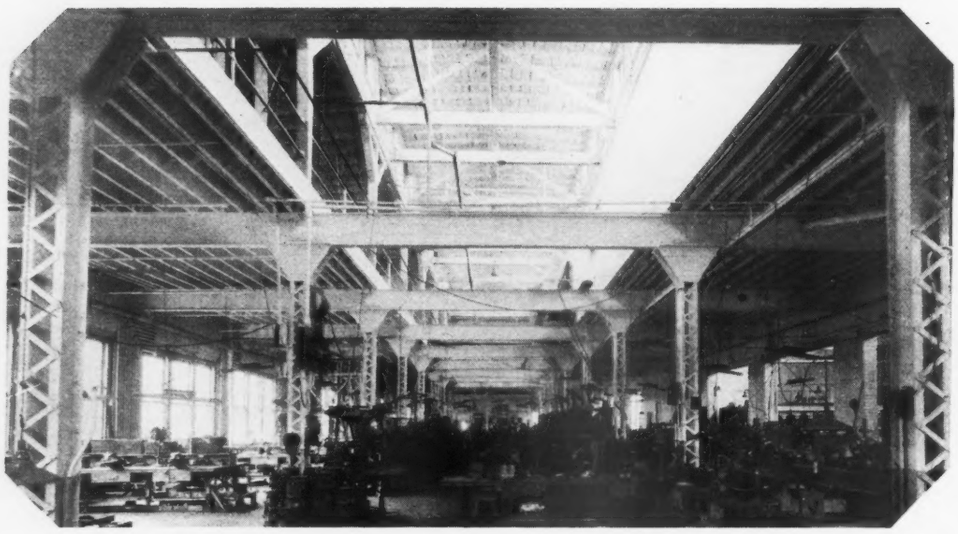
By GARLAND LUFKIN
Chief Engineer
Owens-Illinois Glass Company
Toledo, Ohio

PREVIOUS articles* published in *Industrial Engineering* discussed and described "Organizations for Plant Engineering" from the point of view of the individual plant, wherein the supervision of all plant-engineering activities is a function of the immediate organization. The purpose of this article is to tell how plant-engineering activities in branch plants of a company are co-ordinated through the supervision of a central engineering organization which is located at company headquarters.

Through expansion by acquisitions and mergers, the Owens-Illinois Glass Company, Toledo, Ohio, operates 18 widely scattered plants. With the exception of two sand plants and a paper mill all are glass manufacturing plants, the chief products of which are bottles, jars, and similar articles. The sand plants prepare and provide practically all of the bulk ele-



*"How We Are Organized for Maintenance and Plant Housekeeping," W. G. Ross, Chief Engineer, The United States Aluminum Company, New Kensington, Pa., April, 1929. "Organization for Plant Operation and Maintenance" (organization of E. J. Brach & Sons, Chicago), July, 1929. "Organization for Plant Engineering," E. D. Smith, Maintenance Engineer, National Cash Register Company, Dayton, Ohio, September, 1929. "A Practical-Ideal Organization for Plant Engineering" (composite of fifteen organizations), L. C. Morrow, October, 1929. "Plant Maintenance Under Divided Authority," C. A. Ziebarth, General Superintendent, Bell & Howell Company, Chicago, Ill., February, 1930. "Organized Plant Engineering," Alfred Vaksdal, Plant Engineer, J. W. Romig, Mechanical Superintendent, Corning Glass Works, Corning, N. Y., October, 1930.



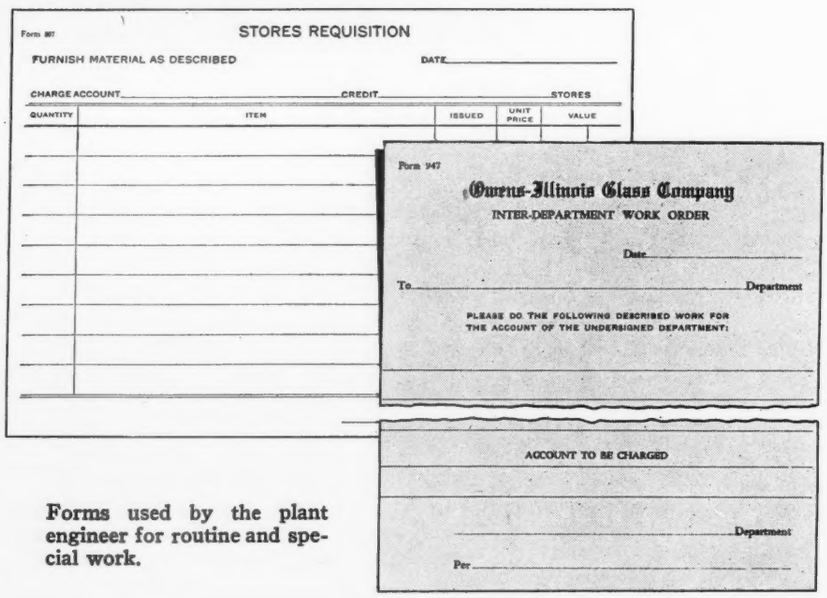
All painting is done in accordance with a standard scheme. The mold shop shows to what extent its application is carried.

ment, whereas the paper mill furnishes raw stock which is sent to the branch plants for ultimate fabrication into corrugated paper and box-board containers.

Because of the diversity of equipment necessary to operate the manufacturing and supplementary plants, the need for the services of a balanced, central engineering organization becomes apparent. Its adoption has effected certain economies that could not be obtained were each branch plant staffed with equivalent talent. In addition, it insures the coordination of plant-engineering activities of all branch plants by reducing procedure to a standard basis. Headquarters are maintained in Toledo, which is almost equidistant from all important branch locations.

Referring to the accompanying organization chart, it will be seen that the engineering department maintained at headquarters comprises four main divisions under the responsibility of the chief engineer. These divisions are: glass and research; patent development; construction, power and maintenance; mechanical; lubrication engineering; furnace, pot, and lehr. Each division contributes something toward individual plant functions and has direct or indirect contact therewith.

For instance, those aside from the construction, power, and maintenance division do influence plant operations to a certain extent by reason of the plant or plants being the theatre of experiment for new products and processes. Aside from the direct administration contact, the engineering department at headquarters, through the construction, power and maintenance division, enjoys a close relationship with all plants on engineering matters because of the limited organizations at the plants.


Form 887
STORES REQUISITION
FURNISH MATERIAL AS DESCRIBED
DATE
CHARGE ACCOUNT
CREDIT
STORES
QUANTITY | ITEM | ISSUED | UNIT PRICE | VALUE
Form 947
Owens-Illinois Glass Company
INTER-DEPARTMENT WORK ORDER
Date
To
Department
PLEASE DO THE FOLLOWING DESCRIBED WORK FOR THE ACCOUNT OF THE UNDERSIGNED DEPARTMENT:
ACCOUNT TO BE CHARGED
Department
Per

Forms used by the plant engineer for routine and special work.

Each plant, however, is a separate unit supervised by a resident manager. The organization at each plant is complete for production control, purchasing, accounting, plant engineering, and so on. Each plant engineer is directly responsible to the plant manager but also answers to the construction engineer on all engineering matters pertaining to that plant.

When the needs for new construction or for improvements to existing equipment in any plant arise in the executive department, the plant engineer concerned assumes the responsibility for completing the authorized work in accordance with plans furnished him by the construction division. If the idea of new design or suggested improvement originates at the plant, plans and estimates are drawn up by the plant organization, either fully or partially, and referred to the construction division for review. Approval for expenditures must be obtained from the manufacturing and engineering, and operating committees, which are composed of various department heads and executive representatives. Expenditures up to $2,000 and $5,000 may be authorized by these committees respectively; however, beyond the larger figures authorization becomes a matter for the board of directors.

As the final plans and estimates are approved, the manufacturing and engineering committee begins to function, seeing that such outside contracts as are necessary are made, specifying equipment to be purchased

or provided from the salvage section and, in addition, acquainting the particular plant engineer with complete details involved. Where the work is of considerable magnitude, major purchases are made through headquarters, the purchasing agent providing the plant engineer with copies of all purchase orders. The usual procedure for the purchase of material for work of minor importance is to refer all requests to the local purchasing agent. From this point on the plant engineer is expected to bring the project to a speedy conclusion.

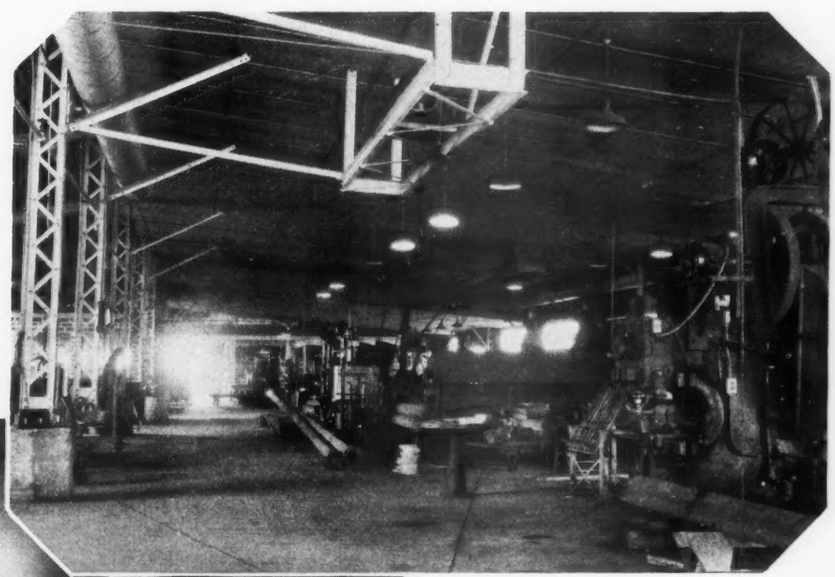
Assigned to headquarters in the construction, power, and maintenance division is a power engineer who oversees all problems incident to power, its procurement and utilization, also water, air, and other services in all plants. Similarly there is attached to headquarters a lubrication engineer who is constantly engaged in the study of the influence of lubrication on power, repairs, maintenance, depreciation, production, and labor.

Again referring to the organization chart, the tie-up between headquarters and branch plant personnel is shown by means of a dotted line extending from the construction, power, and maintenance division. The construction engineer assumes a place beside the various branch-plant managers inasmuch as all plant engineers respond to the dictation of both offices. However, in matters of routine plant procedure or local plant policies, the plant engineer is responsible only to the plant manager, his immediate superior.

Each plant engineer builds his maintenance organization to suit the needs of the particular plant and, owing to the character of the equipment to be serviced, it is essential that the force employed consist of skilled hands sufficient to meet all requirements. Of the 18 plants making up this company, the Alton (Illinois) plant is, perhaps, the most modern and, accordingly, its plan of organization for maintenance and other plant-engineering activities is outlined.

Some of the features of the plant are as follows: It requires approximately 1,800 workers under normal conditions, and since it employs the process of making glass and glass products on a continuous basis, these employees, maintenance men included, work in 8-hr. shifts. A conception of the extent of the plant may be had by referring to the illustrations. It occupies approximately 75 acres. The greater portion is under roof, and includes a wood-box factory, a corrugated box mill, central machine and mold shops, and an experimental laboratory. About 4,500 hp. represents the connected load which is made up from over 1,300 motors in constant service, with capacities of from ⅛ to 650 hp., and 19 electric annealing ovens. With the exception of a 1,000-kw. generating unit which is used for emergency and load-balancing purposes, all power service (gas and electricity) are purchased. As referred to previously, matters of this kind come under the jurisdiction of the power engineer, however, supervision of the equipment utilizing these services is rightly within the premise of the plant engineer who allocates his force accordingly.

This force consists of 90 employees



Interior of machine shop that serves the construction section. It provides working facilities for all trades, including welding in all forms.

Quarters occupied by the electrical force. Motor repair and rewinding is done in the room with entrance to the right of the office.

who are distributed as follows: construction 50; electrical 18; mechanical 6; power 14; drafting 1; office force 1. The construction section has assigned to it welders, pipe fitters, tinsmiths, blacksmiths, bricklayers, painters, carpenters, and laborers. Adequate quarters with complete facilities are provided for them in a modern machine shop which is centrally located within the plant.

All mechanical equipment other than the automatic bottle-making machinery is serviced by the six men assigned to mechanical repair. Of the electrical section two men are engaged on motor and control repair work in the electrical shop which is shown in an accompanying illustration. New construction requires the services of two electricians; checking and calibrating pyrometers and other meters is the full-time occupation of another man; whereas the remainder, excepting a chief electrician and an office boy, is utilized in maintaining production equipment.

To service completely the plant's operations, which are on a three-shift per day basis, the balance of the electrical maintenance crew is divided accordingly and assigned to certain territories within the plant. These men, trouble shooters and their helpers, change shifts weekly, but always report to their designated locations; however, they are summoned for emergencies in any section of the plant that is the direct responsibility of either of the other two gangs. Each gang is supposed to service its own territory, inspect, and lubricate equipment to withstand production activities for the two shifts intervening, that is, until they report for duty sixteen hours later. A visual record is kept on a board in the electrical headquarters of the troubles of the month charged up against the responsible crews.

All work to be done, other than that of a routine character, is authorized by means of a work order, for which material is drawn on a stores requisition. Facsimile copies of these forms are shown. With the exception of standard forms on which production data are supplied to headquarters, no other forms are used in carrying our plant-engineering functions.

Where certain equipment is removed from service owing to production or process changes, a complete list of the material is made up and transmitted to the salvage officer located at headquarters. All plant engineers contribute information of this character to the same center and all draw from this source information on equipment available for use.

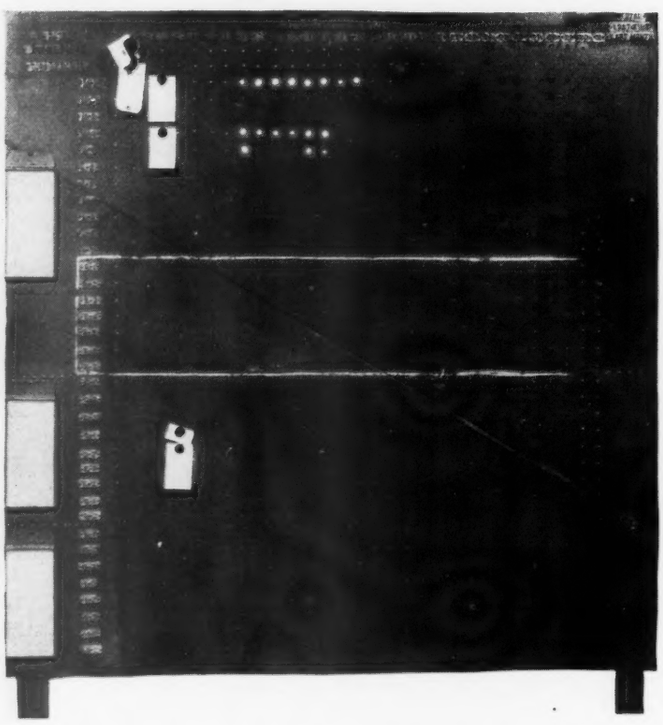
Building upkeep is an important factor at all plants because the major portion of production activities is carried on indoors. Painting is essential for the preservation of the buildings, but no attempt is made to conform to a schedule. At each plant this work is planned in advance, however, taking the buildings in turn as they need attention.

As a guide for all plant engineers in their painting problems, headquarters has provided a manual which outlines certain colors and mixtures that have been adopted as standards for specific applications. The principal object of the manual is to simplify painting problems, making all applications conform to standards, and saving plant engineers' and purchasing agents' time in dealing with paint manufacturers' representatives. It lists the characteristics of paints (30 colors) for acid, water, and heat conditions, specifying quantity for a unit area, whether suitable for brush or spray gun, and quantity of thinner required for different air pressures when used in spray guns. Each paint is given a temperature rating of minimum and maximum limits to which it is to be subjected. Where pipes carrying plant services are designated by color, those recommended by the A.S.M.E. are specified.

Paint is requisitioned in the desired quantity according to number. In this and other fields the headquarters engineering staff provides, wherever possible, out-of-the-ordinary working tools so that each plant engineer may profit by its experience.

Similar standardized procedures have been set up for lubrication; the lubricating engineer attached to the staff of the general engineering department assists the local plant management, through the plant engineer, in carrying out correct lubricating practices. This system will be explained in a subsequent article.

The fuel and furnace division functions to maintain a close check of the comparative efficiency with which fuel is utilized in those parts of the manufacturing processes pertaining directly to the melting of glass; to determine by investigation the cause of inefficiencies, to work out changes in construction, and to correct those features which are not chargeable to improper operation.



Breakdowns of the month are recorded on this board in the electrical department quarters by means of tags and colored pins. The three tablets at the left contain the names of the crews responsible for specific plant sections.

Sufficient apparatus for emergencies, rigidly enforced inspection—Two good reasons for the low fire loss at the Canton plant of the Timken Roller Bearing Company

One of the seven hose houses located about the yard. This equipment is used to protect the substation. The foam generator is in the position it occupies when in service.

Fire in the Plant?

possibly—but not for long

By E. E. GREENE
Safety Director

THERE is no room for argument about the importance of effective fire protection systems in industrial plants. About the only remaining question is what actually constitutes an effective system. Opinions on this phase of the matter may, and probably do, differ; it is something that calls for special consideration in each individual case. Generally speaking, effective systems are based on (*a*) sufficient apparatus to take care of possible contingencies, and (*b*) a system of thoroughly organized and rigidly enforced inspection that will assure permanent fitness of the equipment.

Both these rules have been observed carefully in establishing the fire protection system in force at the Canton plant of the Timken Roller Bearing Company. The plant consists of two separate units, a steel mill and a bearing factory, each with its own problems. The real complication, however, arises from the fact that there are two large oil-storage reservoirs, located within the plant, having a total capacity of 1,000,000 gal. There is also a 45,000-kw. substation that requires an individual protection system.

In the bearing factory there are 5 40-gal. engines of the foam-producing type and 20 40-gal. soda and acid extinguishers as well as an overhead sprinkler system. The portable apparatus is mounted on trucks located at strategic points about the factory and steel mill. There are also 3 5-gal. and 152 2½-gal. extinguishers of the foam-producing type, 50 2½-gal. soda and acid extinguishers, and 240 1½-qt. fire guns, mounted at points where they will be of greatest service.

Oil storage is protected by 2 16,000-gal. foam-producing tanks, each equipped with two sets of pumps, one steam- and the other electrically driven. Ordinarily the steam pumps are used, the electrically driven units being held in reserve. These pumps have a capacity of 135 g.p.m. at 120-lb. pressure, and supply mains that lead to a group of foam hydrants located about the yard.

Water mains supply both fire hydrants and sprinkler systems. They are separate 6-in. underground lines, under pressures of from 55 to 80 lb. This system is entirely independent of the regular plant water system, even being supplied from a separate source. There are seven hose stations at various points around the yard, each consisting of a brick building containing a hose, a hose reel, and other accessories. Altogether there are 7,000 ft. of 2½-in. cotton-jacketed fire hose in these stations.

The substation is protected by its own system, which includes, for inside protection, an automatic CO_2

SODA & ACID

FIRE EXTINGUISHER

NOT SAFE ON

ELECTRICAL FIRES

No._____

Last Date Charged

_____

By_____

NOTICE TO EMPLOY

If This Fire Extinguisher Is Use
Safety Department At Once. Ke
Around This Extinguisher Clear Th
May Be Easily Seen And Readily
THE TIMKEN ROLLER BE

Posted on extinguisher boards, these cards identify type of equipment, give date of last inspection, and state whether or not the extinguishers may be used on electrical fires.

A pair of foam-generating hand extinguishers mounted on their red-painted board. The cards state that they are not safe on electrical fires.

system for the three m.g. sets, supplemented by three portable CO_2 machines and a number of carbon-tetrachloride hand-pump machines. The main oil circuit breakers on the roof, and the transformers in the yard are protected by a foam system consisting of foam generator, powder, hose, and accessories stored in a hose house nearby. In case of fire, foam is pumped to the roof through a 3-in. standpipe to which is connected a length of 2½-in. fire hose long enough to reach the most distant switch. Transformers in the yard and in the basement are reached by hose from the foam generator. A fire alarm box, connected on the plant alarm circuit and located just outside the substation door, sends alarms to the plant fire headquarters and to the city fire department simultaneously.

An organized volunteer fire department of 30 members, selected for their fitness, carefully trained and paid by the company, operates the equipment. A corps of full-time inspectors makes day and night inspections of equipment. The volunteer organization furnishes patrols which are on duty in the plant from Saturday evening to Monday morning and also on holidays and at other times when the plant is shut down. A copy of a Fire Department Inspection Manual is issued to each inspector. It covers in detail all the equipment used in the plant and forms the basis for the training of the inspectors.

In this plant fire equipment can never be used for other purposes, such as flushing sewers or furnishing service water. As a result, one source of spoiled hose and frozen or otherwise incapacitated hydrants is eliminated. No one is permitted to close a sprinkler valve without permission from the safety department. If a valve has to be closed for repairs or other reasons, there is attached to the valve a tag that stays on as long as the valve is shut off. At the same time a stub is posted at headquarters, and remains there until the valve is reopened, inspected, and sealed. Fire extinguishers located on cranes, where the fire inspector cannot get at them handily, are checked by the crane inspector. Crane operators are required to bring their used 1½-qt. fire guns to the electrical maintenance shop and hang them on a rack provided for the purpose. The fire inspector visits this rack every day and refills the extinguishers; the crane man then collects his fire gun and puts it back on the crane. Any employee using a fire extinguisher anywhere in the plant must send or bring it to fire headquarters immediately for refilling.

Most of the equipment is under constant supervision. First-aid fire appliances which protect particularly hazardous places are subjected to an especially close scrutiny, as is the electrical substation protective equipment. Every inspection is recorded on forms provided for the purpose

CARBON TETRACHLORIDE

FIRE EXTINGUISHER

SAFE ON

ELECTRICAL FIRES

No._____

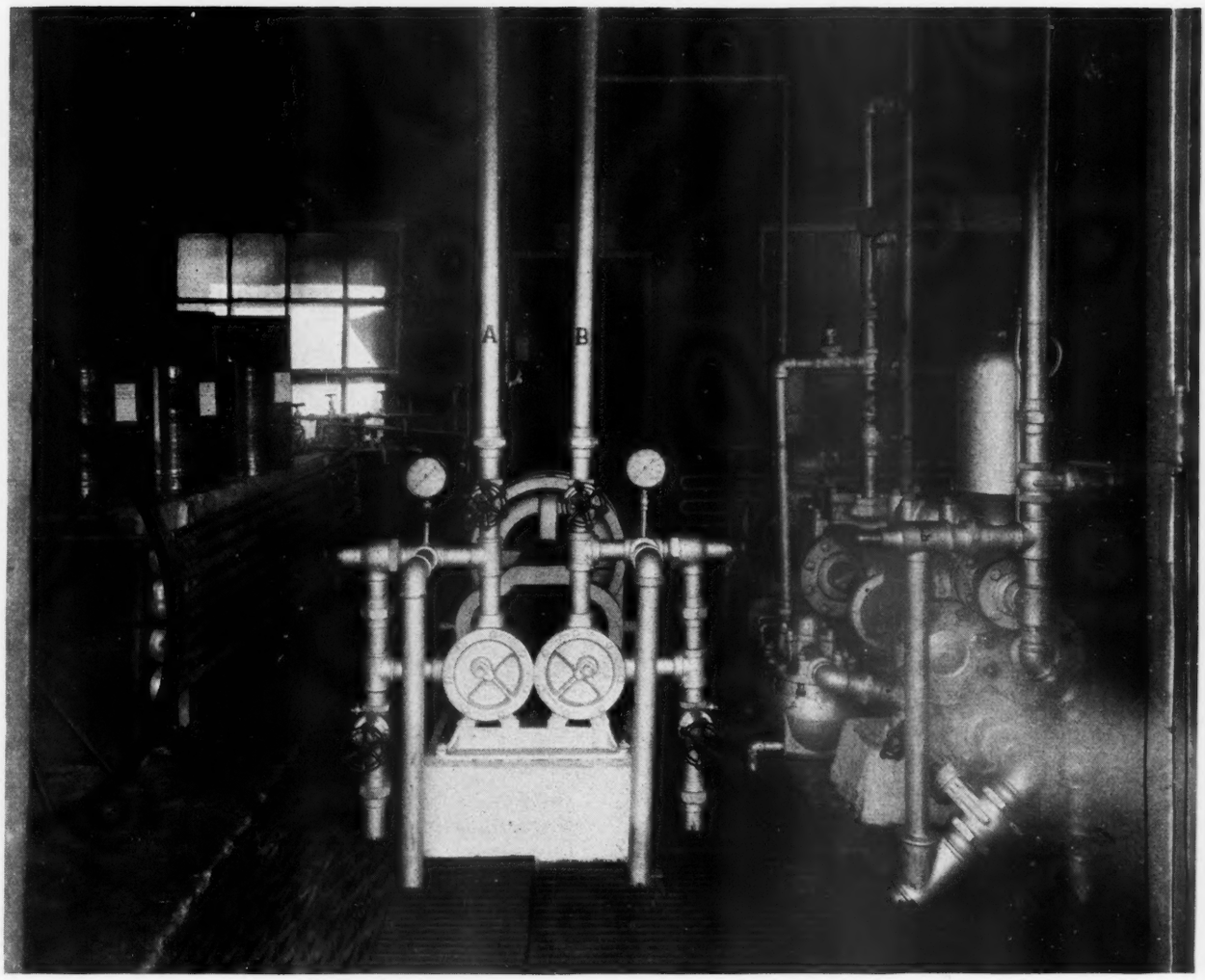
Last Date Charged

_____

By_____

NOTICE TO EMPLOYEES

If This Fire Extinguisher Is Used Notify Safety Department At Once. Keep Space Around This Extinguisher Clear That Same May Be Easily Seen And Readily Reached.
THE TIMKEN ROLLER BEARING CO.



The two sets of pumps that protect the oil storage reservoirs. The steam-driven units are used normally. The electrically driven pumps are held in reserve.

and, at the end of the week, these forms are bound and filed for future examination by either insurance inspectors or company officials.

Every precaution has been used to eliminate safety hazards that might be involved in the use of fire apparatus.

Ladders used on sprinkler tanks, building roofs, and to valves on sprinkler and oil lines were selected to meet state and accident insurance specifications.

Extinguishers are placed where there will be no danger in reaching them, and those dangerous for use on electrical equipment are never located close to switchboards, transformers, oil circuit breakers or motors. In addition, posted beside each extinguisher is a card which identifies the type, gives the date of the last inspection, and carries in red letters the statement, "Not Safe on Electrical Fires," or "Safe on Electrical Fires," as the case may be. The extinguishers are mounted on boards painted red. The boards make the extinguishers conspicuous, and mark the locations as exclusive for that type of equipment.

Sprinkler-system valves are numbered, and a green card giving their location is posted near the foreman's desk in each department. This card also carries the company's rules governing the closing of sprinkler valves and the general maintenance of sprinkler equipment.

Every possible precaution has been taken, not only against fire itself, but against failure or incapacitation of equipment. It is believed that the two are inseparable—the best equipment money can buy is worse than useless if it is allowed to get in condition where it is likely to fail when most needed. This policy, plus careful selection and location of equipment and equally careful selection and training of the volunteer personnel, has been primarily responsible for the low fire loss in the plant.

Spindle Motor Capable of 10,000 R.P.M.

ARAYON spindle motor said to operate successfully at a speed of 10,000 r.p.m. has been announced in *Textile World*.

The problem of lubricating this motor was met by a complex system of reservoirs, filters and pumps. The oil, when it meets the specially selected ball bearings in the motor, is in the form of vapor.

The lubricating system provides a continuous flow of oil from a large reservoir to assure proper lubrication over long periods of time.

INDUSTRIAL ENGINEERING

L. C. MORROW, *Editor*

Vol. 89 FEBRUARY, 1931 No. 2

A Single Breaker May

But the Tide Is

NOT often do we give over any great part of the two editorial pages to quotations from something someone else has written. In this instance we cannot resist the temptation; we quote from Lord Thomas Macaulay's *Essay on Southey's Colloquies on Society,* published in the *Edinburgh Review,* January, 1830. For its being brought to our attention, and for the title, we are indebted to Mr. B. F. Affleck, president of the Universal Atlas Cement Company.

This dissertation, written 100 years ago, is an editorial peculiarly appropriate for publication today. It actually refers to the year 1930. We cannot be disheartened by the recession of a single prosperity breaker when we read this prophesy written in 1830 and then look back over the tide of industrial and social progress of the last 100 years.

"HISTORY is full of the signs of the natural progress of society. We see in almost every part of the annals of mankind how the industry of individuals, struggling up against wars, taxes, famines, conflagrations, mischievous prohibitions and more mischievous protections, creates faster than governments can squander, and repairs whatever invaders can destroy.

"We see the wealth of nations increasing and all the arts of life approaching nearer and nearer to perfection in spite of the grossest corruption and the wildest profusion on the part of rulers.

"The present moment is one of great distress. But how small will that distress appear when we think over the history of the last forty years;—a war, compared with which, all other wars sink into insignificance;—taxation, such as the most heavily taxed people of former times could not have conceived;—a debt larger than all the public debts that ever existed in the world added together;—the food of the people studiously rendered dear;—the currency impudently debased, and imprudently restored.

"Yet is the country poorer than in 1790? We firmly believe that, in spite of all the misgovernment of her rulers she has been almost constantly becoming richer and richer. Now and then there has been a stoppage, now and then a short retrogression; but as to the general tendency there can be no doubt. A single breaker may recede; but the tide is evidently coming in.

"If we were to prophesy that in the year 1930, a population of fifty millions, better fed, clad, and lodged than the English of our time, will cover these islands—that Sussex or Huntingdonshire will be wealthier than the wealthiest parts of the West-Riding of Yorkshire now are—that cultivation, rich as that of a flower-garden, will be carried up to the very tops of Ben Nevis and Helvellyn—that machines constructed on principles yet undiscovered will be in every house—that there will be no highways but railroads, no travelling but by steam—that our debt, vast as it seems to us, will appear to our great-grandchildren a trifling encumbrance, which might easily be paid off in a year or two—many people would think us insane.

Recede—

Coming In!

"WE prophesy nothing; but this we say—if any person had told the Parliament which met in perplexity and terror after the crash of 1720 that in 1830 the wealth of England would surpass all their wildest dreams, that the annual revenue would equal the principal of that debt which they considered an intolerable burden—that for one man of £10,000 then living, there would be five men of £50,000; that London would be twice as large and twice as populous and that nevertheless the rate of mortality would have diminished to one-half of what it then was—that the post-office would bring more into the exchequer than the excise and customs had brought in together under Charles II—that stage-coaches would run from London to York in twenty-four hours—that men would sail without wind, and would be beginning to ride without horses—our ancestors would have given as much credit to the prediction as they gave to Gulliver's Travels.

"Yet the prediction would have been true; and they would have perceived that it was not altogether absurd, if they had considered that the country was then raising every year a sum which would have purchased the fee-simple of the revenue of the Plantagenets—ten times what supported the government of Elizabeth—three times what, in the time of Oliver Cromwell, had been thought intolerably oppressive. To almost all men the state of things in which they have been used to live seems to be the necessary state of things.

"We have heard it said, that five per cent is the natural interest of money, that twelve is the natural number of a jury, that forty shillings is the natural qualification of a county voter. Hence it is, that though, in every age everybody knows that up to his own time progressive improvement has been taking place, nobody seems to reckon on any improvement during the next generation.

"We cannot absolutely prove that those are in error who tell us that society has reached the turning point—that we have seen our best days. But so said all who came before us, and with just as much apparent reason.

" 'A million a year will beggar us,' said the patriots of 1640.

" 'Two millions a year will grind the country to powder,' was the cry in 1660.

" 'Six millions a year and a debt of fifty millions!' exclaimed Swift—'the high allies have been the ruin of us.'

" 'A hundred and forty millions of debt,' said Junius—'well may we say that we owe Lord Chatham more than we shall ever pay, if we owe him such a debt as this.'

" 'Two hundred and forty millions of debt!' cried all the statesmen of 1783 in chorus—'what abilities, or what economy on the part of a minister, can save a country so burdened?' We know that if, since 1783, no fresh debt has been incurred, the increased resources of the country would have enabled us to defray that burden, at which Pitt, Fox and Burke stood aghast—nay, to defray it over and over again, and that with much lighter taxation than what we have actually borne. On what principle is it, that when we see nothing but improvement behind us, we are to expect nothing but deterioration before us?

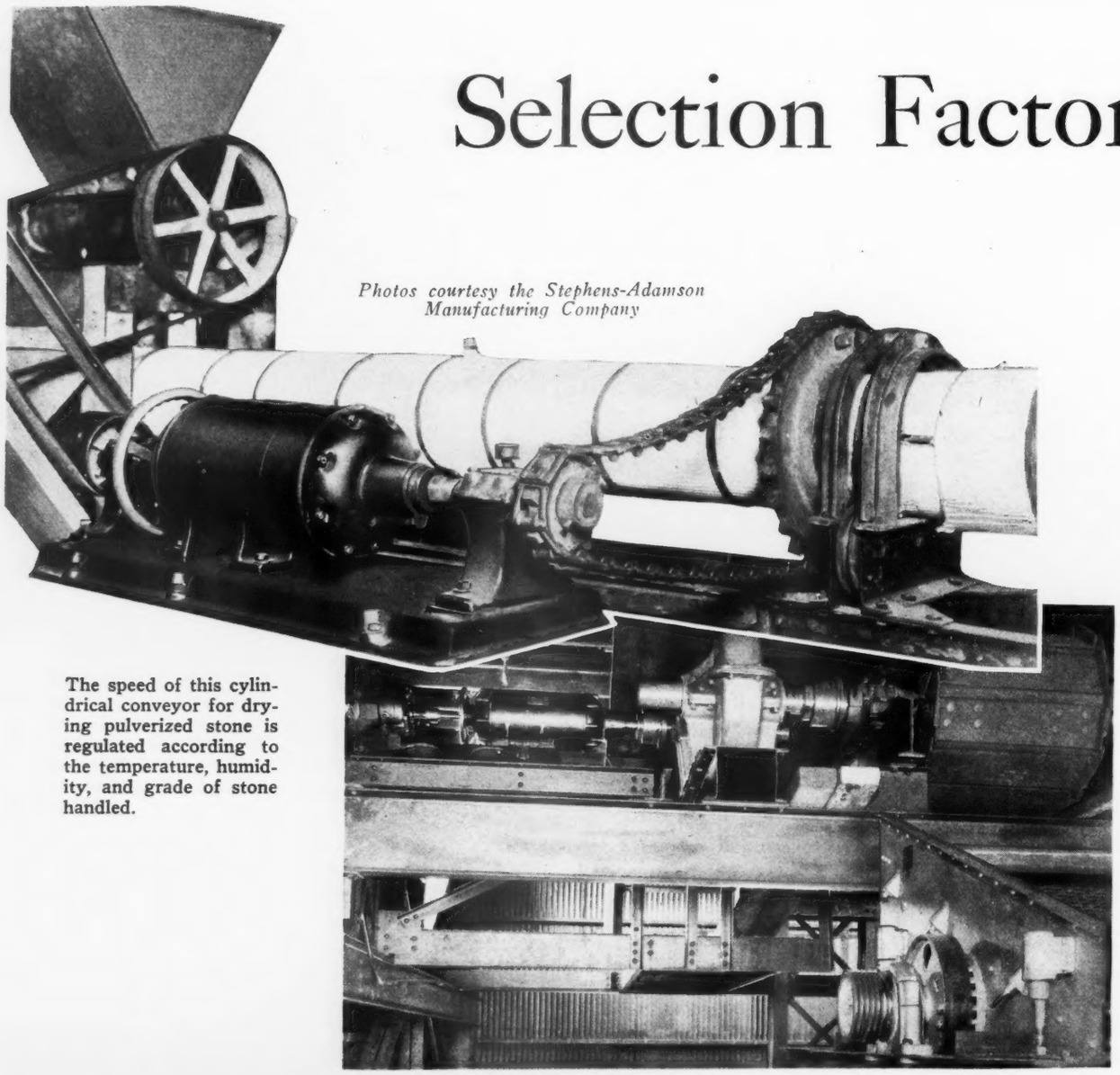
"It is not by the intermeddling of Mr. Southey's idol—the omniscient and omnipotent State—but by the prudence and energy of the people, that England has hitherto been carried forward in civilization; and it is to the same prudence and the same energy that we now look with comfort and good hope.

"OUR rulers will best promote the improvement of the nation by strictly confining themselves to their own legitimate duties—by leaving capital to find its most lucrative course, commodities their fair price, idleness and folly their natural punishment—by maintaining peace, by defending property, by diminishing the price of law, and by observing strict economy in every department of the state.

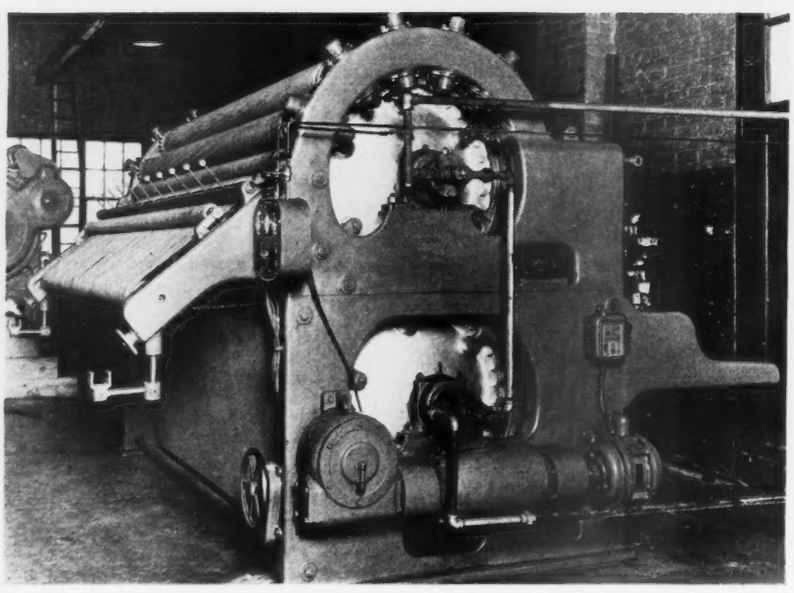
"Let the Government do this—the People will assuredly do the rest."

Selection Factors

Photos courtesy the Stephens-Adamson Manufacturing Company



The speed of this cylindrical conveyor for drying pulverized stone is regulated according to the temperature, humidity, and grade of stone handled.



This feeder withdraws limestone slabs from a 500-ton surge bin and delivers to a crushing and screening plant in any volume from 50 to 350 tons per hour. By turning the handwheel on the variable-speed transmission the feeder speed can be changed to any speed between 6 and 42 ft. per minute.

Laundry mangle with a very flexible control consisting of three sets of push buttons and gages. One set controls the variable-speed drive, a second set regulates the temperature of the ironing rolls, while the third increases or decreases the pressure between rolls as the mangle handles light or heavy pieces.

for Variable-Speed Transmissions

Imagination has something to do with plant efficiency. The knowledge of what other plants are doing is quite likely to stimulate the plant engineer's imagination with the result that he will improve his own methods or equipment applications. To illustrate this contention, consider power transmission and, specifically, variable-speed transmission.

A MANUFACTURER reports that the applications of his line of variable-speed transmissions run all the way from laundry mangles to painted clouds and scenery for movie sets. He tells also of a drive used to control the speed of an exercising machine designed to provide work-outs for overweight people. By means of the speed variator the machine can be operated slowly at first, speeded up as the exerciser warms up, and tapered down at the finish.

Among the other uses for variable-speed drives that have come to his immediate attention are these:

To determine the best operating speeds for packing various products in cans of different sizes. In this case the equipment is used by the research department.

To determine the best speeds in conveying food products through a continuous oven—another research job.

For controlling the speed of stoker grates. This is an automatic job, the speed being increased or decreased by the action of decreasing or rising steam pressure upon a mercury column.

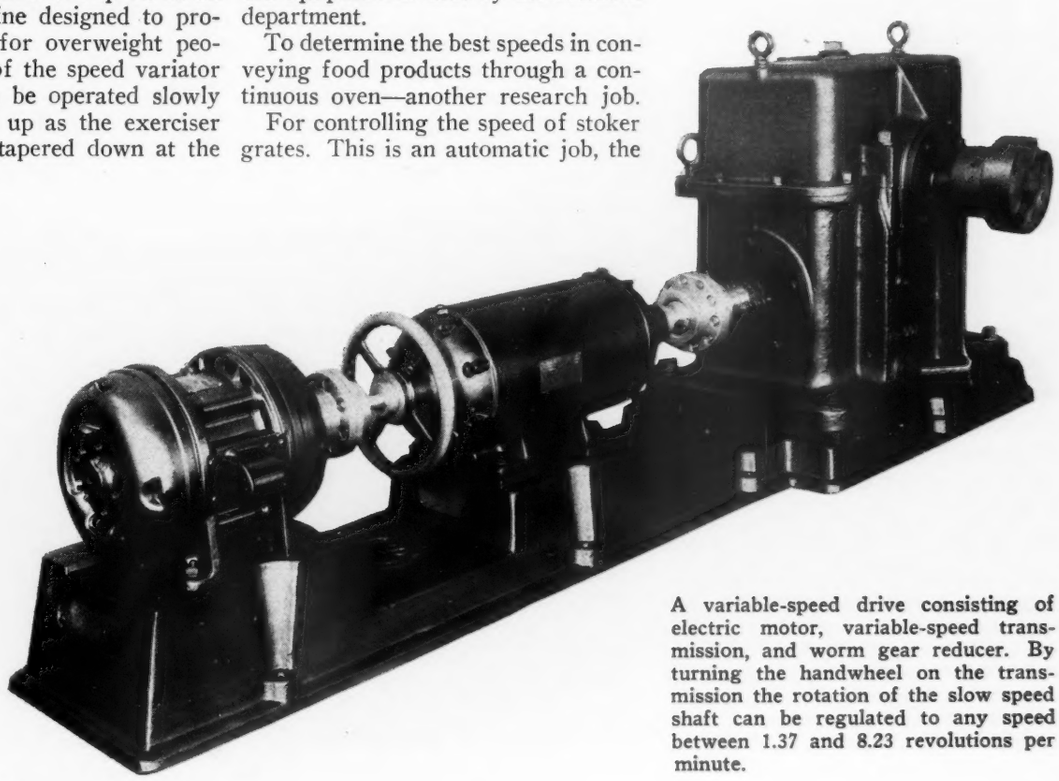
To cut labels of different sizes from continuous rolls of paper.

To slice shingles of different sizes from rolls of composition roofing.

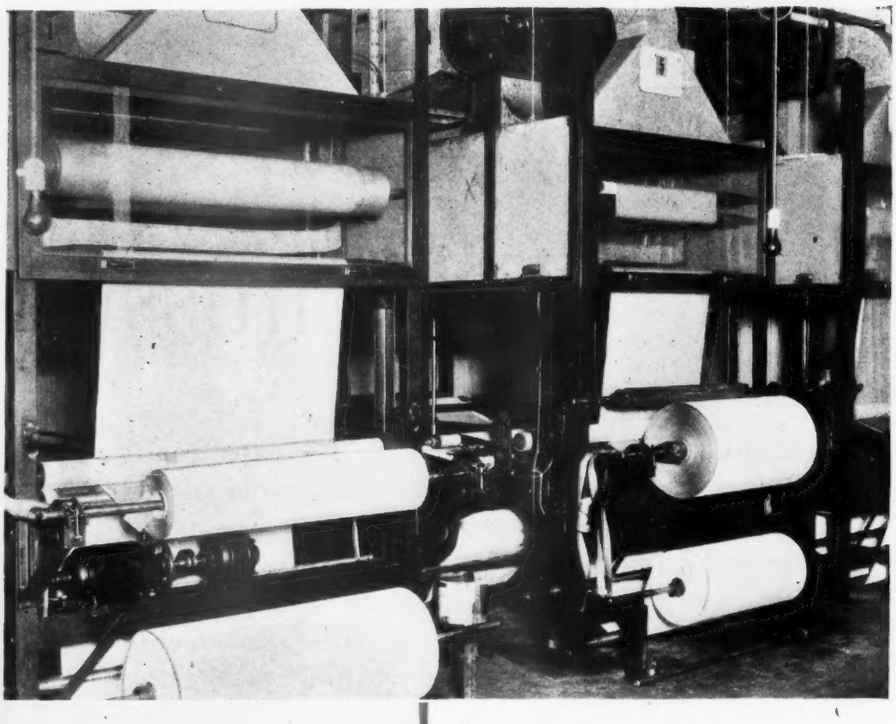
To vary the speed of metal parts through plating solutions.

To regulate the feed of materials being carried on conveyors through stone-crushing plants, ore mills, and factories. Typical are the control of pumps for regulating the amount of molasses added to grains and the control of the feed of wire through drawing and tinning processes.

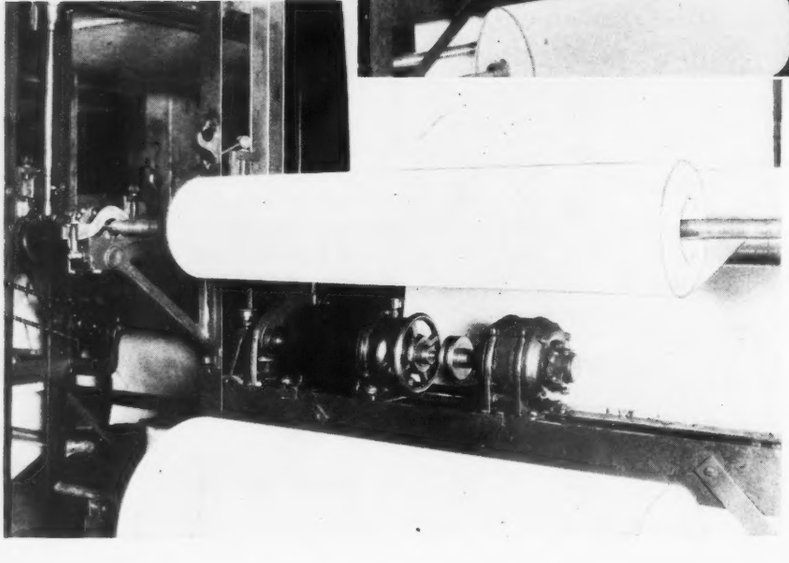
Additional examples of types of equipment lending themselves to the



A variable-speed drive consisting of electric motor, variable-speed transmission, and worm gear reducer. By turning the handwheel on the transmission the rotation of the slow speed shaft can be regulated to any speed between 1.37 and 8.23 revolutions per minute.



The speed at which blueprint paper is coated with a sensitizing solution, dried and rolled, is controlled by means of the variable-speed drive shown. To get a uniform paper the speed must be regulated to suit the width of paper, atmospheric condition, and the solution used for each lot of blueprint paper.



application of variable-speed transmissions are:

Assembly and inspection conveyors
Feeders, pumps and mixers
Glass tempering conveyors
Gear shapers, planers and lathes
Continuous heat-treating furnaces
Painting and drying ovens
Baking ovens and batch mixers
Laundry mangles and washing machines
Blueprint sensitizing machines
Dryers, screens, stokers
Wire-tinning machinery
Bottling and textile machinery
Ventilating fans
Printing presses

Operation of practically every one of the types of equipment heretofore mentioned is dependent upon the kind of material handled, variations in atmospheric and temperature conditions, weights and sizes of materials. The human element also is a variable of considerable influence.

The accompanying illustrations show installation examples of variable-speed transmissions controlling the movement of materials in some of the kinds of work mentioned.

It is the function of the plant engineer to discover wherein the variable-speed transmissions can do a given job for him better than can any other type of power-transmission equipment. He must then decide upon the kind of variable-speed transmission that he wants.

In doing so he must consider:

1. The power source, speed and horsepower needed.
2. The range of operating speeds wanted.
3. The range of speeds of the different makes of transmissions considered.
4. The mechanical efficiency of the transmission at different speeds.
5. Durability and maintenance costs.
6. Inclosed or open type preferable.
7. Compactness and ease of mounting.

The range of speeds probably is the feature that will require most careful attention. Practically all types of variable-speed transmissions will deliver an indefinite number of speeds within the range over which they operate. The range may determine whether or not a gear or chain reduction will have to be used between the motor and transmission. Conversely, prior determination as to the use of gear or chain reduction may determine the speed range of the transmission equipment that will be selected.

There also will be taken into consideration the question of whether or not under the existing non-variable conditions there can be obtained a transmission that will combine the function of speed changer and speed reducer.

AROUND the WORKS

A section devoted to short articles describing practical methods devised to meet specific operating conditions. The items may refer to details of installation, inspection and testing for maintenance, wiring, repair, and replacement.

Vibration Adds to Electrical Troubles

THERE is no doubt that breakdowns and running troubles are caused by vibration. If an armature is out of balance it will vibrate excessively when running at full speed. With high-speed machines it may be sufficient to make the commutator brushes flutter thus causing sparking, flat spots and so on.

Although armatures of most modern machines are properly balanced vibration may result after running for some time, from too much play in the bearings or unequal air gap.

London, England. W. E. WARNER.

Centralized Service Equipment Insures Better Supervision

PLANT engineers are realizing the advantage of keeping the service equipment in any factory in one location, so that it can be under the constant supervision of an operating man. Oftentimes we have gone through plants and noticed an air compressor in one corner of the building, a switchboard in the other, water cooling equipment in the basement, various pumps near the elevator, the main steam valve and other appurtenances located on different floors of the factory. The conclusion drawn is that it was necessary for the maintenance man to spend most of his time watching this equipment, and to stop and start it necessitated a delay because it was spread out in different parts of the plant.

When an opportunity came to build a modern shoe factory, it was our plan to place all service apparatus in one room, consequently all high-pressure steam piping, heating system, water supply, gas pipes, telephone, and air equipment are located in this room which also houses the main control valves.

We also located the switchboard, water meter, gages, and drinking-water cooling system in this section where the maintenance man, who has charge of oiling, stopping and starting of equipment of this type makes his head quarters, keeps his supplies, tools, and repair parts. The advantages of this plan are readily apparent as it gives an ideal arrangement not only from the point of view of cost, but continuity of service.

An accompanying illustration shows this room in detail. We have found it was less expensive to install the equipment in this manner, than to have it located in other sections of the factory. In this way one man is responsible for the equipment. If the apparatus had been widely scattered it would have been impossible to have concentrated the responsibility. We recommend this idea to other plant engineers who are anticipating changes in their factory equipment.

K. D. HAMILTON.

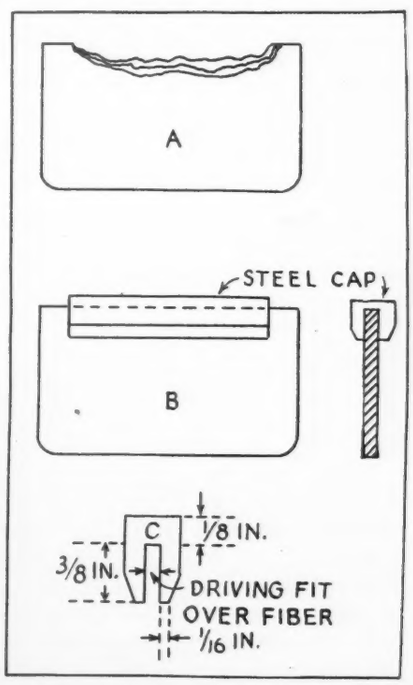
Mechanical Department
Geo. E. Keith Company
Campello, Brockton, Mass.

Localizing all plant service equipment at one point simplifies its supervision.

Steel Cap for Fiber Drifts

ALL repairmen and armature winders who use fiber drifts know that the top edge soon becomes badly mushroomed and battered over, as in *A* in the sketch, thereby reducing their usefulness and effectiveness.

There is also an element of danger in using a mushroomed drift as bits of fiber are apt to break off and injure someone.



The steel cap shown in *B*, and made up according to the dimensions in *C*, will prevent mushrooming as in *A*.

Mushrooming can be eliminated by making a steel cap that can be used repeatedly. This cap, as shown in *B*, consists of a piece of cold-rolled steel or brass 6 or 8 in. long, milled out in the center for a driving fit over the fiber drift.

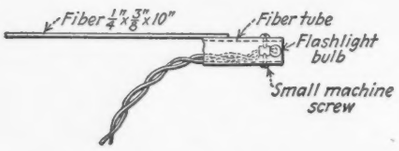
General dimensions are indicated in *C*, but these can be altered to suit the caps.

Wilkinsburg, Pa. A. C. Roe.

Handy Light for the Electrical Repair Shop

WHEN inspecting the backs of the risers before starting armature repairs, or making examinations in other places that are difficult to get at, the little, portable electric light described below will be a valuable aid. The illustration shows how it is made.

The fiber tube that contains the small



A flashlight lamp bulb is mounted in the fiber shell of a cartridge fuse.

flashlight lamp was formerly the shell of a 30-amp. cartridge fuse. A piece of fiber ¼x⅜x10 in. is riveted to the tube. The cord connecting the lamp and the battery can be made as long as required. The lamp, which operates on one dry cell, is readily procured anywhere.

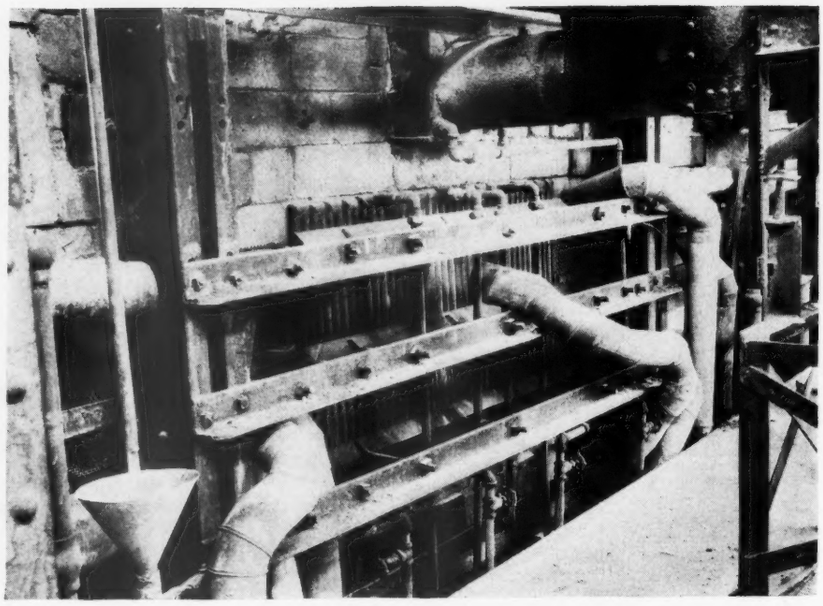
The entire assembly is so small that it can readily be inserted in places where it would be impossible to use ordinary lamps. It is especially useful in armature repair work.

Chas. A. Peterson.
Chief Electrician,
Cold Spring Granite Company,
Cold Spring, Minn.

Furnace Wall Support Prevents Premature Shutdown

OF the several methods used in making temporary repairs to furnace walls, the one illustrated was used effectively in a glass plant. Owing to continuous service the interior of the furnace deteriorated from the day it was placed in operation, continuing until the weakness was apparent from the exterior.

Because of production demands it was impossible to discontinue the furnace until repairs could be made, and in fact, it would take almost as long to rebuild the furnace as it would to repair it temporarily. Knowing that the balance of the furnace was in a



Radiator-type furnace wall support prevents complete exhaustion of refractory material because of the cooling action of the circulating water. At the weakest point in the wall the radiator is actually cool.

safe and satisfactory condition for continued operation, the plant engineering department proceeded to make the wall serve its purpose until complete overhauling would be justified.

Pieces of ordinary gas pipe were cut to a length to overlap the weak section. These pipes were welded into a radiator through which water could be forced as a cooling medium. The radiator when mounted on angle-iron strips was forced against the wall and held there by means of angle irons bolted to the furnace columns.

Although forced draft is used to a limited extent, circulating water is depended upon to carry off the excessive heat flowing through the thin brick shell remaining. By keeping this thin shell comparatively cool complete exhaustion of the refractory material will be postponed, and consequently the furnace can be kept in service for an extended period.

Reluctance Method Replaces Destructive Tests

Photo courtesy Westinghouse Electric & Manufacturing Company

Testing welds without destroying them. The welded seam is bridged with a large horse-shoe magnet and the magnetic field in the vicinity of the weld is explored with a meter which indicates reluctance. By comparing the magnetizing forces across the weld with those of the steel plate the quality of the weld is determined.

Improvised Method of Baking Small Motor Windings

RECENTLY I was faced with a problem where proper equipment was not on hand and a substitute was used, which I believe would be beneficial to others similarly situated.

A small single-phase motor was sent in for repairs. Upon examination I found the starting winding burned up. Obtaining the correct winding data, I proceeded to wind the starting coils, placed them in the stator slots, after which I applied the insulating varnish. At this point I was faced with the problem of baking the winding, but I had neither oven nor heating units, so I decided on the following method.

Having made all connections to the winding, applied the insulating varnish and attached one end bell of the motor, I inserted an 150-watt lamp with the aid of an extension cord in the stator. With the current turned on sufficient heat was obtained from the lamp to bake out the winding.

I closed the motor end through which the lamp was inserted with asbestos paper and allowed the winding to bake out. Sufficient air for circulation was obtained from the openings in the end bell.

The improvised baking oven worked well inasmuch as the motor is now giving satisfactory service.

Dallas, Texas F. J. H. KRAUSE.

Sound-Proofing the Test Room

IN carrying on final inspections and tests on milling machines at the Kearney & Trecker Corporation, Milwaukee, Wis., disturbing influences from the manufacturing area are avoided through the use of a sound-proof test room. The tests conducted include the cutting of various metals with miscellaneous cutters at slow and high speed ranges, using feeds ranging from minimum to maximum.

For this class of work it is quite essential that outside noises are eliminated, hence the special test room, in which the tests can be conducted independently of other manufacturing work.

When this room was built, it was necessary to raise the roof somewhat in order to permit the inclusion of a 5-ton crane which serves the entire test floor area. At the same time, a daylight skylight, with a modern ventilating system was installed so that fresh air could be circulated in warm weather. For heating in colder weather, unit heaters are employed.

As shown in detail in the accompanying line drawing, the construction of the walls is such that the entire inclosure is airtight. The wall framework is made up of 2 x 4-in. members, with a panel extending from the floor to a height of about 40 in.

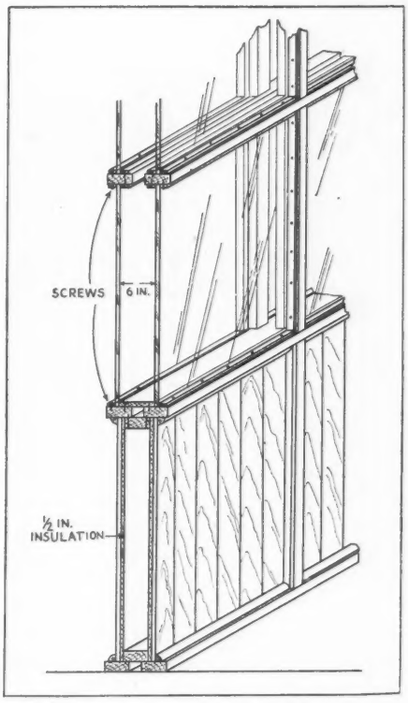
From this point upwards, glass windows are used.

At the base the air gap is lined on both sides with a ½-in. section of insulite.

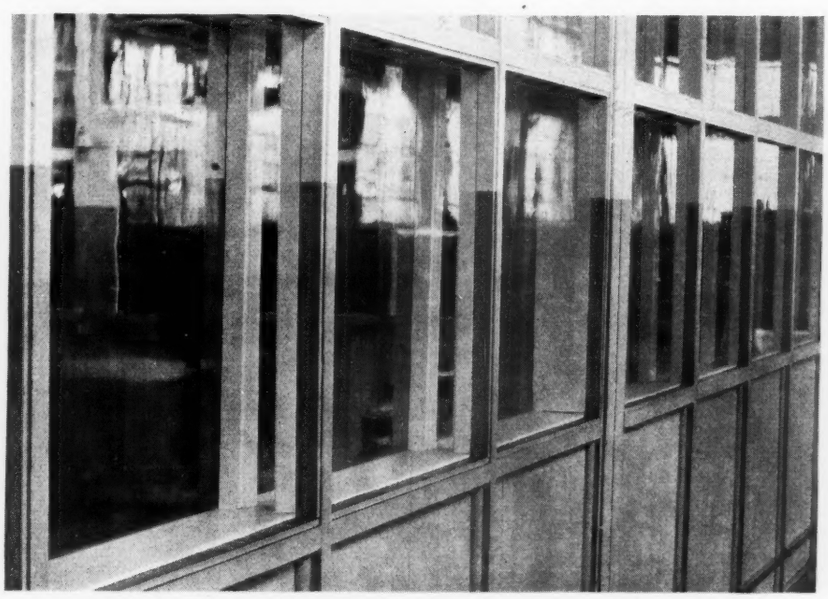
A feature of the glass inclosure is the provision for removing the inside glass frames when cleaning is necessary. However, after more than six months' use, the inside surfaces of the windows are just about as clean as they were when installed originally. As a result, cleaning is anticipated about once a year.

The framework on the outer panels for the glass is nailed to the sills or frame, whereas the inner panel is nailed on one side only. The outer strips that hold the glass are secured in place by means of screws and washers, which permit the removal of all the glass in the inner panels at any time.

FRANK W. CURTIS.
Research Engineer
Kearney & Trecker Corporation
Milwaukee, Wis.



Construction details of the sound-proofing partition between the test room and the manufacturing space. The air gap at the base is lined with insulite. The windows on one side only are removable for cleaning.



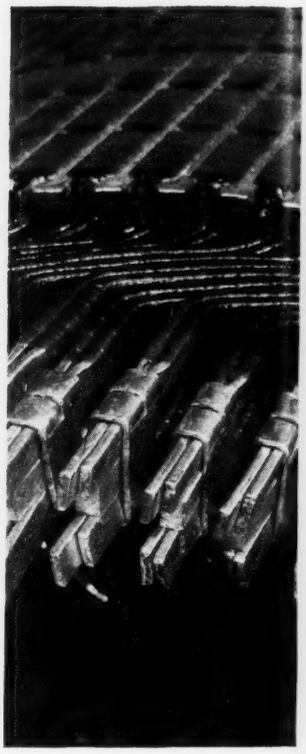
Close-up view of sound-proofing partition in which is built a double row of windows. Between the windows is a 6-in. space which acts as a silencer in preventing the noises from the manufacturing space from entering the test room. The windows in front are fixed, whereas those on the opposite side are removable.

Two-Speed Bandsaw Drive

I WAS interested in reading of the electrical two-speed control for bandsaw, in December *Industrial Engineering*. It brought to mind a certain bandsaw with built-in, two-speed, mechanical control. The machine was to be used for cutting both wood and metal, the speed for metal being only about half of that for wood. Simply by changing saw blades and gears a bandsaw for one material was quickly converted to a bandsaw for the other.

Peoria, Illinois. JOHN E. HYLER

Securing Windings in the Slot Section of Rotors



By A. C. ROE

Renewal Parts Engineering Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THOSE portions of windings installed in the slot sections of rotors must be secured against centrifugal force and side motion; this means that the windings should be installed and anchored in a manner that will minimize movement. With this in mind it is obvious that the slot insulation for any rotor is of great importance.

The term slot insulation includes the insulation applied to the slot sections of the coil, and that used when inserting and fastening the coils in place, as each is selected and applied with the ultimate objective of securing a tight winding. Numerous methods are employed to insulate armature or rotor coils, but in this article the discussion will be restricted to the slot insulation used when installing the windings on the core.

The function of slot insulation is to prevent conductance of electrical energy from the windings to the core and between adjacent turns or layers. A portion of the slot insulation is used for mechanical protection, and filling excess space. To serve its purposes properly, the insulation must have such characteristics as good dielectric and mechanical strength and resistance to disintegration under operating temperatures.

For convenience we can divide rotors into two classes: (1) open slot, and (2) partially-closed slot. With open slots, three retaining methods are used: (a) by means of core bands; (b) by means of fiber, wood, micarta or metal wedges; (c) use of a combination of core bands and wedges. With partially-closed slots, wedges are used, with very few exceptions. On open-slot rotors it is general practice, with some exceptions, to use insulating material to protect the coils from the core during installation. These pieces of insulation are termed winding cells, and may be used as single or double cells, as will be explained.

Winding cells for open- or partially closed-slot, wedged rotors should be cut shorter than the total length of the wedges. The top edges are trimmed to permit turning over

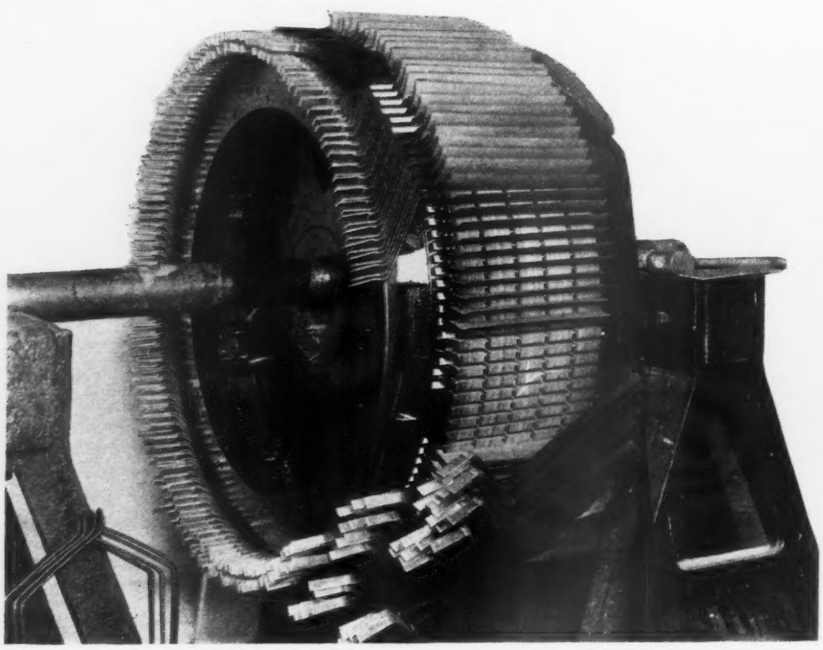


Fig. 1—Details of the slot insulation used with a partially closed slot, wedged, threaded-in, strap-copper-coil winding. Note the long drift used to drive the coils into the slots.

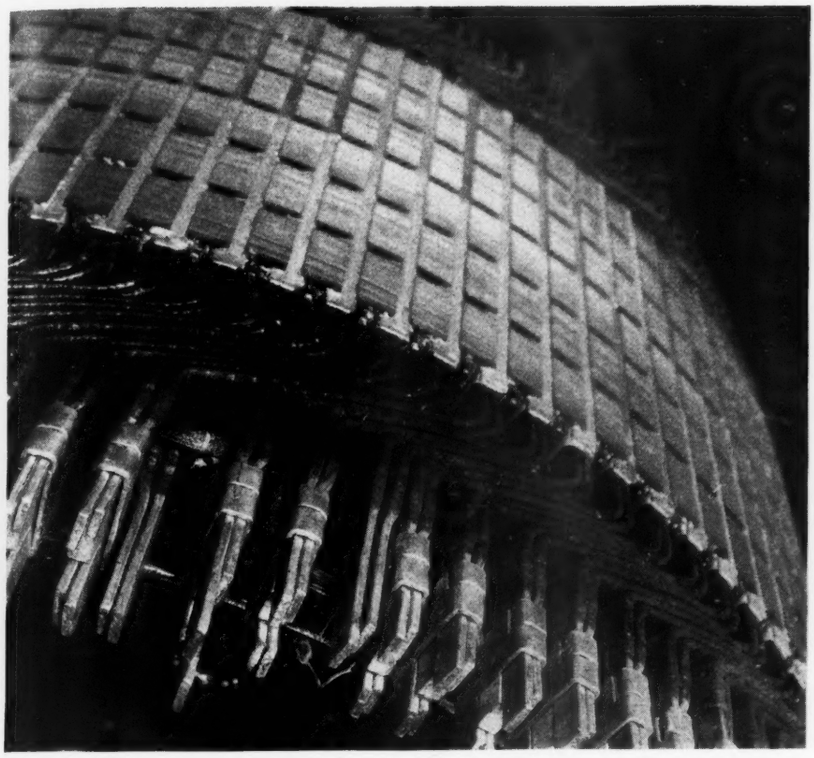


Fig. 2—Close-up view of the winding in Fig. 1, showing the top fillers and wedges.

on top of the coils. Filling strips of fishpaper, fiber, or treated wood are used to make the coils a tight fit depthwise, by taking up excess room in the slots. When possible, these filling strips should be divided into three parts: one at the bottom of the slot under the winding cell, a second between the layers of coils in the slot, and the third under the wedge and on top of the turned-over winding cell.

The filling strip under the wedge helps in driving the wedge, as the winding cell is held down and does not tear and double up ahead of the wedge. The bottom filling piece, when $\frac{1}{8}$ in. or more in thickness, is generally made from treated hardwood. The thinner filling strips are cut from fiber or fishpaper according to the thickness required. Bottom fillers should fit the slot snugly widthwise and be placed under the winding cell. Bottom fiber fillers can project $\frac{1}{4}$ in. to $\frac{1}{2}$ in. on each side of the core, but wood or fishpaper fillers should end flush.

Center fillers should be a snug fit widthwise, inside the winding cell, and project past the bend of the coil. However, when the insulation on the coil ends is bulkier than that on the slot section, the center fillers should be cut to fit between the high spots, filling them in to prevent a buckle in the slot portion of the coil.

Side fillers are used to make the coils a snug or driving fit, taking up any excess room widthwise in the slots. These fillers should not extend past the core lengthwise, nor extend above the top of the top halves of the coils in the slot. They are placed between the core and winding cells.

Slot insulation for a partially closed-slot rotor having a strap-copper-coil, threaded-in, two-layer, diamond winding is shown in Fig. 1. The fillers are of fiber, and the extension past the core can be seen.

In Fig. 2 is shown the winding in Fig. 1 wedged and ready for the end bands. The wedge in this case is $\frac{1}{16}$ in. thick, straight cut; that is, not machined to any particular shape. Note the filler under the wedges; also, the distance that the wedges extend past the core and the winding cells.

Slots of many open-slot rotors have recesses cut into the teeth near the

Fig. 3—Double winding cells, with U-shaped pieces of heavy fishpaper at both ends of the slots, are used in insulating the rotors of mining and railway motors. The long fiber drift for driving the coils into the slots can be seen below the winder's left hand.

top of the slot, into which fiber wedges are driven. The wedges vary in thickness and shape according to the type of slot, wedge groove, speed of rotor, etc. When driving machine-shaped wedges, they should be a snug fit; sufficient fillers must be used under the wedge to tighten the winding depthwise in the slot.

Open-slot, unwedged rotors such as used in mill, mining, and railway motors, have the slot-section windings retained by core bands. The slot insulation used results in a tight, compact winding. Double winding cells permit tighter driving fits. With hot banding, dipping and baking insures a winding that will remain tight during long periods of operation.

Double winding cells consist of a separate winding cell for each half of the coil; thus there are bottom and top winding cells. Both cells are of the same length, but the bottom cell is narrower, as it is cut to a width that permits a 1/32-in. extension above the coil on each side, after the coil and cell are in the slot. Top cells are cut wide enough to project 1½ in. to 2 in. above the armature core, as Fig. 1 shows.

In Fig. 3 bottom cells are shown in place in the slots below the mallet. Note that these cells are bent into a U-shape and placed in the upper part of the slot. The bottom half of the coil is placed in this cell; then the coil and bottom cell are driven together down to the bottom of the slot.

One coil has been started into the slot, in Fig. 3. The top cell is placed in the slots on top of the bottom coil half. Fillers are used to make the coils a snug driving fit and all depthwise excess room is filled up with filler strips in the bottom of the slot and between coils. Fillers should not be placed on top of the coils under the bands as they are likely to work loose or warp up into the airgap. All factory coils for this type of armature have a protecting strip of fish-paper taped into the top coil half.

For tight banding, the coils should project slightly above the core in the band grooves. This projection should be 1/32 in. to 3/64 in. for armatures that are hot-banded. Short coil extensions beyond the core and pressure at each end of the slot form potential weak spots which are reinforced by using U-shaped pieces of thick fish-paper at each end of all slots, as shown in Fig. 3. The core is recessed to receive the U-shaped pieces.

For motors operating at high temperatures, the coils have class B insulation, such as asbestos-covered wire, mica wrappers, and asbestos tape, and winding cells are omitted in the majority of cases. Strips of micarta are used for filling up excess room widthwise or depthwise in the slots, to make a tight winding.

To prevent frequent pull-ins or breakdowns, careful consideration should be given to slot insulation. Materials and their methods of application, methods of wedging and applying core bands, operating temperatures, and other conditions should be checked to determine whether the proper slot treatment is being incorporated in the winding or windings.

BOOKS

Artificial Sunlight

By M. Luckiesh, D. Sc., director Lighting Research Laboratory, Edison Lamp Works—National Lamp Works, General Electric Company, Published by D. Van Nostrand Company, Inc., 250 Fourth Ave., New York, N. Y. Cloth, 246 pages, illustrated. Price, $3.75.

FOR thousands of years artificial light was employed solely to enable mankind to find its way about, and do its work after the sun had set. An instinctive knowledge that the sun's rays contained, in addition to light, something that is beneficial and essential for life and health received little scientific attention until the latter part of the past century. An immense amount of study and research has since brought out many facts of the utmost importance. On the basis of these facts the era of dual-purpose lighting is being ushered in. In its simplest terms it means simulating sunlight so as to provide whatever health benefits there are in summer sunlight, while furnishing light for vision.

In this volume the author has assembled and discusses the information now available for the development of safe and efficient substitutes for midsummer sunlight. Among the subjects discussed are: Solar radiation; effects of spectral energy; a basis for measuring physiological effects of radiant energy; reflection of ultraviolet radiation; transmitting media; incandescent solids; measurement of ultraviolet radiation; arcs.

In the discussions the effects of radiant energy have been co-ordinated with the physics of the subject—a combination that is oftentimes lacking in biological researches and in therapeutic practice.

Those who are interested primarily in health maintenance, as well as engineers whose chief concern is artificial lighting will find in this book much to interest and inspire them.

The Menace of Over-Production

Edited by Scoville Hamlin. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price, $2.75.

WRITTEN by specialists in eighteen fields, and dealing with today's most serious problems—over-production and unemployment, this book is peculiarly appropriate for study at this time. Like "Whither Mankind" and "Toward Civilization," it discusses the complications of this machine age.

It neither condemns nor finds blameless our growing industrial mechanization, but aligns the facts, and then attempts to point out a path that can be followed.

Code for Lighting Factories, Mills, and Other Work Places

Published by the American Standards Association, 29 West 39th St., New York, N. Y. Price 20 cents.

THIS revised American Standard (A11-1930) has been approved by the American Standards Association following its approval by the Illuminating Engineering Society, which took part in the development of the code. The code, which applies to practically all industries, is intended as a guide for factory owners and operators in their efforts to improve lighting conditions in their plants, and also a source of authoritative information for bodies preparing safety regulations. It contains sections on measurement of illumination, recommended levels of illumination, avoidance of glare, specifications of adequate wiring, locating switches, and a suggested minimum regulation to be established by state authorities.

PLANT ENGINEERS' FORUM

Here is the seventeenth of a series of questions, each of which has at least two sides. A new question will be presented next month, and our readers' answers to previous questions also will be published. Write down your opinions and send them to the editor. Answers published will be paid for at an attractive rate.

◆

How Valuable Are Plant Visits?

George Shipman, a works manager, seldom visits the plant where Frank Fulleger is plant engineer, located in the same city, without at least passing the time of day with Frank. In the current episode the curtain rises just after greetings have been exchanged and Shipman has asked Fulleger what he has on his mind.

* * *

"Looks like I'm going to be a globe-trotter, George. The big chief issued orders on the last day of December that I'm to take a trip away from the plant once a month during 1931. How's that for a tough break?"

"What's the idea, Frank? Health failing? Or is the boss getting philanthropic in his old age? Got your February reservations at Miami? And what do you mean by tough break?"

"Health's all right—don't see any extra generosity on the part of the boss—not going to Miami—and I can't figure it anything else than a tough break to be away from the wife and kids for several days each month. And all for the sake of visiting other plants."

George Shipman looked his surprise. "You must have gotten out of bed on the wrong side this morning, Frank. Looks to me like opportunity is giving you the big knock. In my opinion a little absence from the family will make you appreciate them all the more—and maybe doing without daddy for a few days at a time will give said family an increased fondness for the nominal head of the house. But aren't you mixing family and business affairs?"

"Give me time, George; I was just about to say that with all the improvements I have under way now I'm needed right along at the plant. Beside all that, I have a hunch that not many plants are ahead of us in maintenance; bet we can give most of them cards and spades and little casino——"

"Wo, Frank—and back up. This doesn't seem like you talking. Has the 'plant engineer' title gone to your head, or are you coming down with the flu? Now that you've done the planning, how about letting your understudy carry things through? And don't be so sure about giving away cards and spades—there may be a joker in the deck. Think this thing over, boy—count your blessings one by one, and consider this one of them—in my humble opinion. See you later, when you're back to normal."

George departed, smiling, as though he thought he could predict a pronounced change of attitude on the part of Frank.

* * *

At first sight it looks as though George Shipman has all the better of the discussion. But ordinarily Frank is a level-headed young man—perhaps George terminated this conversation before Frank trotted out his best arguments. At any rate——

Should maintenance engineers regularly visit other plants? Is the firm justified in financing such visits? Give reasons back of your answers and cite specific cases where your company has profited by your visits to other plants.

(Answers to previous questions start on the following page)

READERS' ANSWERS

to previous questions

Bonus for Maintenance

(Question presented in the January issue)

THE foundation of an honest bonus system requires hard thinking based on common sense and actual facts. No guess work should be allowed, because once a system is established it is for better or worse.

The object of all bonus systems is to stop waste in material, machines, and men.

1st step: Find the average cost of manufacturing any unit article for a period of a year or more.

2nd step: Give the men 50 per cent of the profits involved in the bettering of this average mark.

This average mark will vary according to the different cost of material and labor.

Bonuses should be paid to all men of all departments involved, based only on the individual hourly rating.

By this arrangement every man will be on his job and always ready to help his fellow worker, because he knows that only teamwork will pay him a bonus.

W. E. GIONET, *Assistant Mechanical Engineer*
American Powder Company
Maynard, Mass.

IT is futile to establish any premium system without providing for inspection of the work done. In most small plants this is impracticable and the best solution lies in hiring reliable men and paying them in proportion to their worth. In larger plants, where there is sufficient work of one kind, standards may be established, inspection provided for, and a premium system established the same as on any production work. Because work happens to be done for maintenance instead of manufacture is no reason premium cannot be paid, if suitable standards can be set.

It is the difficulty of measuring the work of the maintenance department which precludes the adoption of a bonus system, and makes it necessary to confine incentive rewards to the larger plants and to a premium system on detailed tasks which can be inspected economically. The management is likely at any time to demand extra work which will destroy the ratio of maintenance expense to production time. They might refuse to buy new equipment to replace old equipment which it is uneconomical to maintain. Either condition would sadly affect the bonus of the maintenance men through no fault of their own.

W. A. WALTER, *Purchasing Agent*
Pneumatic Scale Corporation
North Quincy, Mass.

I DO NOT believe that it is feasible to pay a bonus on maintenance work under conditions prevailing in the average plant. The maintenance department must be considered primarily as a strictly service department and its efficiency measured by its ability to take care of breakdowns and other emergency work promptly. This usually means that it is necessary to take workmen off of a job not yet completed in order that they can take care of emergency work of greater importance. Switching men from one job to another is, of course, expensive, but is generally necessary in order to avoid more expensive delays in production. Certain departments of a manufacturing plant usually are considered more important than others and are given preference on maintenance work.

Another reason that makes a bonus system hard to apply on maintenance work is the fact that in the average plant this work is of infinite variety and the same operation is seldom repeated often enough to establish a fair cost.

I have seen several attempts to use a bonus system on maintenance work. One such system was based on an inspection and estimate on each repair order received by the mechanical department. In spite of having a capable estimator the estimates on which the bonuses were figured were usually subject to considerable criticism and the labor involved in making them was expensive. Often there resulted serious delays in getting the work started in the shop.

A system based on a comparison of maintenance expenses and value of production was considered but deemed to be impracticable on account of the many special factors entering into the case, such as age of the equipment in use, corrosive nature of the products manufactured in some departments, temporary character of certain processes, and so on.

The efficiency of a maintenance department usually is quite evident to the plant management and can be summed up in regular reports covering the new equipment installed, experimental and development work, and general maintenance work, and the heads of this department usually can expect to be recompensed by their regular salaries in proportion to the general results obtained. The mechanics can be paid on a sliding scale covering each trade and the shop superintendent is in an excellent position to judge the workmen's efficiency and recommend that their wages be raised to a higher figure on the scale covering their shop as their efficiency increases.

C. W. SCHWABE, *Superintendent Mechanical Department*
Mallinckrodt Chemical Works
St. Louis, Mo.

A PLAN satisfactory to employer and employee, approximately as follows, could be worked out:

Determine how many and what kind of jobs the maintenance department is required to perform, from information accumulated over a period of several months. Have a disinterested and qualified man estimate the lengths of time that should be required by a good workman.

Keep a record of actual times required and compare them with the estimated times. If there is no serious

discrepancy consider the actual times as a basis for a standard.

After a two-or three-month preparatory period we would have a check upon the accuracy of the time estimates and we could go about the work of setting up standards which should be, say, 15 per cent to 25 per cent under the time actually spent on each job, but not less than the estimated time. With this as a base we would then pay to the individual as a bonus 50 per cent of his saving.

To illustrate: If the actual man hours for a job were 3, the standard would be set at 2 hr. 33 min., if we were using the 15 per cent reduction. If the job were done in 2 hr. by a workman earning 60¢ per hour the time accruing to him would be 16½ min. which, at his rate, would give him a bonus of 16½¢, equivalent to a premium of 8¼¢ per hour above his hourly rate.

A trial period of 30 days during which bonuses would be figured on this basis would permit seeing exactly how the plan would work in actual practice and if it proved to be satisfactory it could be adopted.

It will be understood that because of the large number of different jobs handled in a maintenance department and the necessity of transferring men from one kind of work to another, it would be important that the plan be intelligently supervised by some person who did not share in the bonus. Standards should be carefully considered and if the workmen failed to earn bonuses on each job the cause should be sought.

The bonus plan would be intended to benefit both employer and employee. One that guaranteed each man a bonus for each job probably would be one in which the standards were too low. On account of the great difference in ability of the individuals in any group the standards should be such that the poor or indifferent workman would not earn bonus until he had shown an improvement.

Suitable penalties against the bonus, but not the base rate, would be prescribed for poor work or failures in equipment which were directly traceable to neglect on the part of the maintenance department.

Supervisory employees could share in the bonus by being allowed the average percentage of bonus earned by the group or groups under their supervision.

A. H. GERBER, *Office Manager, East Toledo Factories*
Libbey-Owens-Ford Glass Company
Toledo, Ohio

Shall There Be a National Association of Maintenance Engineers?

(Question presented in the November issue)

IT is doubtful if the formation of a National Association of Maintenance Engineers would be feasible. Where there are many industrial plants within radius of a center such an organization might be formed. Where plants are scattered it probably could not be.

There is the question of who is eligible for membership. Many small plants only employ a single man to handle their maintenance. In some plants there are engineers who are responsible for maintenance in addition to their other duties. The organization would have to embrace master mechanics, plant engineers, chief electricians, and jobbers who are in charge of plant maintenance.

Apparently the best procedure would be for one of the major engineering societies to have a branch along these lines. On the other hand, there are many men who, although eligible along the lines of a maintenance association, might not be eligible to join the engineering society.

All in all, the time is not yet ripe whereby a maintenance engineers' association could be formed and run as a self-supporting body.

M. C. COCKSHOTT, *J. B. Gill Corporation*
Long Beach, Calif.

Who Shall Specify Equipment?

(Question presented in the October issue)

NEITHER the purchasing agent nor the plant engineer should take an arbitrary stand on equipment to be purchased. The co-operation of both is essential for the benefit of the firm whose money is being spent.

It is not expected that the purchasing agent should know equipment performance; the plant engineer is there for that purpose. He should see that the equipment selected will render the service expected regardless of the manufacturer.

H. E. STAFFORD, *Electrical Engineer*
Port Arthur, Ont.

PROVIDING quality is maintained, in accordance with plant engineer's specifications, the purchasing department should exercise its right of determining sources of material supply as a means of obtaining comparative prices on the equipment specified. But, before deciding to buy, the plant engineer should be consulted. His decision should be final in the choice of material when it is a matter of specifying particular equipment for definite locations.

That is the way it should be done—in a spirit of friendly co-operation. Both department heads should be broad-minded when it comes to seeing the other's point of view.

A system that is working satisfactorily in one of our large plants is based on a material classification. Ordinary stock material that in no way affects the maintenance of specific machines is purchased in the open market at the best prices available. This class consists of pipes, fittings, lumber, etc., and for which the plant engineer has provided a standard set of specifications.

Considerable leeway is permitted the purchasing department in obtaining such material.

Definite specifications cover material such as boilers, pumps, motors, control, power-transmission drives, chain conveyors, and so on. Competitive prices are obtained on equipment of equal capacity, which are

submitted to the plant engineer for his decision, inasmuch as he is responsible for its operation.

In this manner co-operation is assured, at least as long as the purchasing department recognizes the responsibility of the plant engineer, and he in turn recognizes the question of price.

K. D. HAMILTON, *Mechanical Department*
Geo. E. Keith Company
Campello, Brockton, Mass.

MORE importance than necessary is attached to the age-old argument between the purchasing agent and operating department heads. Two cents difference in roller bearings is a good example of these dramatic situations, which show a lack of understanding of each other's province.

Technically, the plant engineer is superior, but he should prove to the satisfaction of the purchasing agent why he should pay more for a particular article. There are unscrupulous agents whom some plant engineers cannot resist, but the purchasing agent is accustomed to the methods they employ. The purchasing agent is an aid to have with you rather than against you for he can inform you about things from the commercial side, which often offset technicalities.

My experience in several large corporations is that it pays to co-operate, and in no other way can you get what you want, providing you know what you want. If you are consistent, also correct, any purchasing agent will respect you and your opinions.

JOHN S. ISDALE, *Plant Engineer*
Factory K, International Silver Company
Meriden, Conn

IT has been my good fortune to be associated with open-minded purchasing agents; I have always specified what was needed in power and maintenance work. Sometimes specifications have been definite, at other times "equal grade" has been specified. Many times I have been asked if other makes could be substituted because of price or delivery. Frequently I have accepted the substituted article because I was satisfied that it was O.K. The highest priced article is not always the best.

The man in charge of power and maintenance should most certainly specify what is needed (even to a lead pencil) but he should make his specifications as flexible as possible. He should be big enough to accept advice and suggestions from the purchasing agent without worrying about any principle involved except the principle of the lowest possible equipment costs obtainable with the best possible results. FREDERIC W. CARTER
In charge of Power and Maintenance
Waterbury Clock Company
Waterbury, Conn.

THE relation existing between purchasing and maintenance or plant engineering departments should be one of harmonious co-ordination and co-operation. Where such relation is made a predominating factor there can be but one main objective—that of ultimate plant servicing at lowest cost. The fact that price is not the criterion in lowest ultimate cost cannot be argued.

Purchasing requisitions, together with the necessary specifications that originate in the maintenance or plant engineering department, should carry the name of vendor—particularly so when selections have been made from a servicing and engineering point of view. Where vendor is so specified it should in no case be changed unless there exists in the eyes of the management some reason such as credit, questionable business tactics, etc. But even where such reasons do exist and a change is deemed advisable the originator of the requisition or the department head should be so advised.

This policy should hold when source or make is a criterion. There are, however, many items of stores and general supplies where source of purchase should be left in the hands of stores or purchasing department. Such items will vary with the industry involved, or with location, or managerial viewpoints. For instance, an establishment requiring large amounts of castings may be located in an area wherein several competing foundries are to be found. Thus for the purpose of balancing local business, or for reasons of reciprocity, it may be advisable to distribute this business rather than to purchase from one source alone. Similarly, it may be advisable to so purchase lumber, hardware, and many other more or less standard supplies.

There are many items which cannot be so purchased economically—such as paints, welding rod, taps and dies, and tool steels, where specifications, trial, and price must be given consideration and purchases made according to recommendations as given by the maintenance or plant engineering department.

In conjunction with the purchasing department, records of trials and comparative prices should be kept by the maintenance department. Many items, excluding special equipment, which become standard or are made a stores proposition, are then purchased with a knowledge of their actual service value. Together with this must be carefully watched the maximum and minimum amounts to carry if dead and obsolete stock are to be kept at the lowest possible figures.

H. L. SCHULTZ
Assistant Superintendent of Maintenance
The Carborundum Company
Niagara Falls, N. Y.

A PLANT of sufficient size to enable it to have a purchasing agent on its staff should have an able and competent man for, to him falls the task of studying constantly the plant's needs and giving to the work of purchasing his thorough consideration as to quality and so on.

He has a tough job to keep in touch with every department head, seeing that they are not held up for equipment or material while trying to get prices or better delivery dates. The system of a department head placing his order, with the specifications attached, in the hands of the purchasing agent is sound. However, I think the proper procedure is for the purchasing agent to present his side to the department head after he receives the memorandum order, explaining his views on what the order calls for. As a matter of fact, a department head is not as well posted on where the best for the money is obtainable in spite of his desire to specify a certain make of article. A purchasing agent ought to be specialist in such matters.

When a piece of equipment is needed in our plant, we all are more or less interested in getting just what

our particular department wants, yet we are very glad to consult with our purchasing agent to get his views on what the market has to offer.

For the purchase of raw materials he is guided only by specifications, buying to make the best savings possible.

CHAS. H. WILLEY, *Superintendent of Manufacture*
Hoyt Electrical Instrument Works
Pennacook, N. H.

What Maintenance Policy During Depression?

(Question Presented in the September Issue)

SOME of us remember, as boys in the country, watching the little red hen as she sallied into the pasture lot on a foraging party with her fuzzy chicks, when, all of a sudden, a shadow passed over the brood. There was a squawk from the mother, and a rapid movement under burdock leaves and other places of concealment by the rest of the family.

This brood is representative of the business world when a break in Wall Street casts a shadow upon its individual scratching place. However, it's a wise hen that can tell whether the passing shadow is that of a harmless turtle dove or a menacing hawk. If she decides that the shadow is harmless, she will call out the brood and go about picking up the choicest bits of sustenance and thus accumulate some satisfaction in life for the rest of the day.

In a plant, the first big job to tackle when a depression strikes a nation and shatters business, is to coax the scared managerial chicks from beneath the industrial burdock leaves. These may be owners, superintendents, managers subject to boards of directors, a bunch of hungry coupon-clipping stockholders, or a gang of wild-eyed creditors.

This is the third depression that I have experienced, with a faint recollection of the panic of '92. But this country will never see another panic like that; it isn't possible under our present Federal banking system. The three depressions followed periods of security inflation. With the water squeezed out, the securities return to near their proper value, and the nation runs along in its usual manner. If during a depression, an engineer finds that his plant is in need of repair and funds are being withheld, he can borrow a history from some eighth-grade pupil and prove to his boss the foregoing statements. And he would be justified in razzing him with reference to these matters.

All maintenance is largely regulated by the law of compensation. What is neglected this week will have to be doubly made up next week, likewise what is undone during a depression will cost twice as much when "good times" come. And the chances are it will only be half done.

For taking care of the maintenance work in which to keep a high-class group of satisfied workers, a 9-hr., 5-day-week schedule is the ideal working instrument. Work that cannot be done during operating time, such as boiler cleaning, pipe fitting, moving machinery, and repair can, if properly organized, be done Saturday morning, giving the workers Saturday afternoon off as well as Sunday.

However, these depressions do not last forever, but they approach suddenly and many manufacturers are caught with low stock, depleted equipment and a stack of maintenance work. Theoretically, of course, in an old established plant where finances are sound, maintenance work would continue during the depression. If the funds are lacking all an engineer can do is to list his work and be prepared, as best he can, for the break when it comes.

I am not in sympathy with Frank's idea of not taking a vacation. I cannot imagine that the maintenance of a plant is so refined that one person is unable to take a two-weeks' vacation. It seems that something is wrong with the teamwork, or else the job is permeated with jealousy.

GEORGE S. BILLMAN, *Asst. Chief Engineer*
Arcade Works, Nicholson File Company
Anderson, Ind.

Do Centralized or Decentralized Stores Better Serve Maintenance?

(Question Presented in the August Issue)

TO do justice to his job and himself, a maintenance executive can hardly be expected to shoulder the details involved in carrying out a stores system other than in an ex-officio capacity in advising what and what not to carry in so far as plant maintenance equipment, materials, and supplies are concerned. His ability is far more valuable when devoted to up-keep of plant, development work, and in solving the countless problems that present themselves from day to day. There are exceptions to this stand in small industries and where personnel or organization will not justify separate departments, but these cases are exceptional.

Where careful study has preceded the installation of a centralized stores system, taking into account not only the needs of the industry as far as supplies, material, and equipment are concerned, but equally important—that of set-ups, records, and effective distribution—there can be little argument against the fact that it is an aid to efficient maintenance.

In the problem discussed by Frank and George there is a centralized stores system that does not seem to be functioning efficiently. The argument brings to light a laxity in keeping up-to-date records. A system, whether centralized or decentralized, will not fulfill requirements unless a definite knowledge exists of all items to be carried, also essential records to show the status of each and every item at any time. In substance, a perpetual inventory system.

There are other factors of no small value in the eyes of management, which have swayed the trend towards centralized stores departments. Not only does it make a perpetual inventory practical, but obsolete and slow-moving stocks may be reviewed, listed, and drawn to the attention of the department heads interested. It is an effective tool in maintaining minimum requirements.

Where centralized stores exist there is less possibility of duplication of material, and consequently capital invested, less duplicated effort and lower overhead. There are conditions where branch stores under the control of a central system fit into the picture, such as those catering to the electrical and other departments, but the point is that they are actually under centralized control.

Where a centralized stores system is effectively established there is definite responsibility all along the line. Emergency parts mentioned by Frank and George can be controlled through the centralized store system and charged to the department upon receipt with little excuse for delay on this account.

H. L. SCHULTZ
Assistant Superintendent of Maintenance
The Carborundum Company
Niagara Falls, N. Y.

How Big Is Maintenance?

(Question Presented in the May Issue)

FROM a plant executive's point of view, maintenance should be the keeping of plant equipment in such shape as to bring about maximum production with minimum lost time and at lowest cost. The belief that a maintenance crew should be repairing something all of the time is a mistaken one, since when repairs are being made the equipment is idle and production is lost.

It is more economical to maintain an idle maintenance crew than idle equipment.

Maintenance, therefore, consists of something more than merely repairing equipment. Maintenance properly should begin with the purchase of equipment, and should continue throughout the installation. Only equipment that is known, or that is fully guaranteed, should be purchased in the first place and no expense should be saved in seeing that it is properly installed if its life is to be anything like normal and the maintenance costs minimum.

Men who have to maintain equipment are usually the best judges of what type of equipment is best; and they know how to install it.

After equipment is installed and in operation, the next consideration is to keep it going. The one sure method of doing so is proper inspection. Inspection and lubrication generally go hand in hand, since all equipment that has revolving parts must be periodically lubricated; therefore, with the proper inspection of equipment while being lubricated, much time is gained, and overlapping of duties is eliminated.

Trouble always has a source, which at first is generally trivial. For instance, it seldom happens that a belt comes apart all at once. If glued, the seam opens at one point and gradually extends until the splice is opened. Again, a bearing does not wear away to the same extent as if held against a grindstone, but the wear is gradual. Proper bearing inspection has saved much in motor burnouts alone, since a low motor bearing usually has disastrous results. A good maintenance crew should be about three jumps ahead of trouble at all times.

Maintenance is therefore so big that it means life to an industrial plant, for without maintenance there will be very little production. To sum up, maintenance should include:

1. The selection of equipment
2. The installation and supervision of equipment
3. The inspection of equipment
4. The repair of equipment
5. The salvaging of equipment.

H. E. STAFFORD, *Electrical Engineer*
Port Arthur, Ont.

YOU have touched upon a vital question in asking "How Big Is Maintenance?" Management is just beginning to appreciate it. In your discussion you have not covered all phases of the question.

"Plant engineering" is the title which should be carried by the man in charge of all physical property who is responsible for construction, development, design, and research so far as mechanical processes and the prevention of waste are concerned.

Consider development and design. Suppose that the company desires a new plant or changes in machinery, or development of machinery. There are involved selection of site for the plant, determination of engineering data preliminary to drawing plans, development of plans and specifications, drafting, estimating and budgeting, cost comparison, design of new machinery, manufacture and superintendence of this machinery to conform to any particular process which may be developed.

After the plans have been constructed and detailed, there is the actual physical construction program which involves the letting of contracts, inspection, selection of materials, contracts with outside construction departments, as well as the building which can be handled through the plant department itself.

Then comes operation, even broader than any of the other activities. It covers the generation and distribution of heat, light and power, and the operation of buildings and grounds as concerns layout of machinery, ventilation, service equipment, protection, insurance as related to laws and ordinances, watchmen and police, safety organization, sanitation, cleaning and upkeep of grounds.

These particular phases of operation also pertain to process equipment involving performance of machines, speeds, temperatures, voltages, pressures, efficiency, and safety.

Maintenance, when classified with the other functions, is one of the duties assigned to the plant engineer. It covers general repairs and inspections of buildings, equipment and machinery, the lubrication of all apparatus, general repair work, and upkeep. It includes the superintending of the men of all mechanical trades, such as machinists, blacksmiths, electricians, pipefitters, carpenters, pattern makers, painters, tinsmiths, millwrights, roofers, masons, yard laborers, pipe coverers, and contractors.

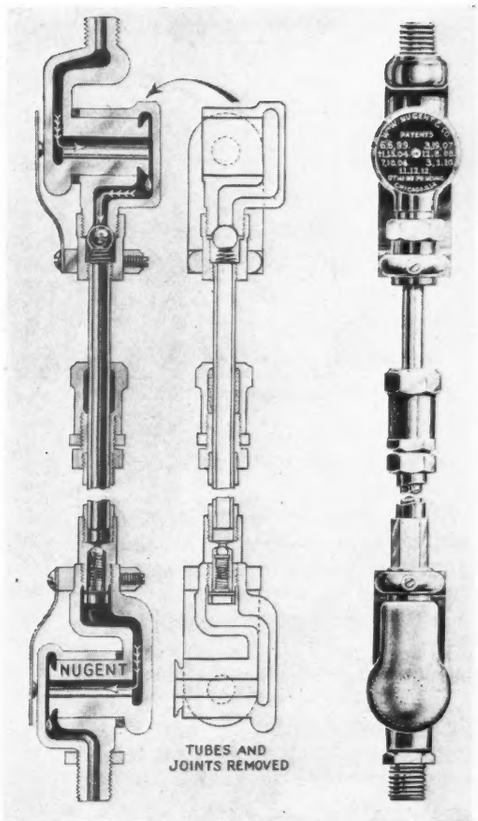
Plant engineering is a big problem, because it covers such a diversity of subjects, and the man who can handle this type of job must be well rounded in all phases of engineering. Is there any other executive who has larger responsibilities, not only from the point of view of dollars and cents involved, but because he must be on the job every minute in order to produce a smooth running machine which will insure a con-

(Please turn to page 89)

LUBRICATING SYSTEMS

Central force-feed and gravity types

By FRED H. LOW
Mechanical Engineer



Courtesy Wm. W. Nugent & Company, Inc.

Fig. 28—Pumps and conveyor combined as a unit and actuated by reciprocating motion of cranks or eccentrics to which it is attached. It consists of telescopic tubes attached to swivel joints.

A SYSTEM designed for force feeding lubricants to crank pins and parts that provide a reciprocating motion is shown in Fig. 28. The arrangement consists of a pair of telescopic tubes attached to swivel joints; one at the crank connection, the other at some fixed point near or in the plane of rotation of the crank. A stuffing box is provided on the end of the large tube at the point where the smaller one enters it. Ball check valves are arranged so that, by the action of the crank, oil is forced or pumped to the bearing.

In Fig. 29 is shown schematically another single-pipe distributing system having a much broader field of application than the one just described. With the single pump used any number of feeders from 5 to 100 may be accommodated. This pump is of the two-cylinder, plunger type with piston valves positively driven from a main shaft actuated from some moving part of the machine being lubricated. The plungers are of steel, and are ground and lapped to fit. The oil intake is through a fine screen of large area which is easily accessible for cleaning.

A stream of oil in excess of the bearing requirements is delivered by the pump. It makes a complete circuit of the single pipe line, the excess returning to the pressure control valve in the reservoir. This valve is of the rotary plate type and is driven by worm and gear from the pump shaft. It is closed once every 15 revolutions of the pump, remaining closed 5 per cent of the time.

When the valve is open the oil has free circulation and the pressure is only that required to overcome the resistance due to flow. When the valve is closed the oil is delivered against a pressure relief valve which gives a short pulsation or kick of sufficient intensity to operate the needles in the feeders at the points of application.

Fourth article of a series. The next will appear in an early issue.

Connected with the moving part of the relief valve, and located above the cover of the reservoir, is a button which makes a jump at each pulsation on the line. As this button is in the return end of the oil circulation line its movement is taken as a visual indication of the proper working of the system.

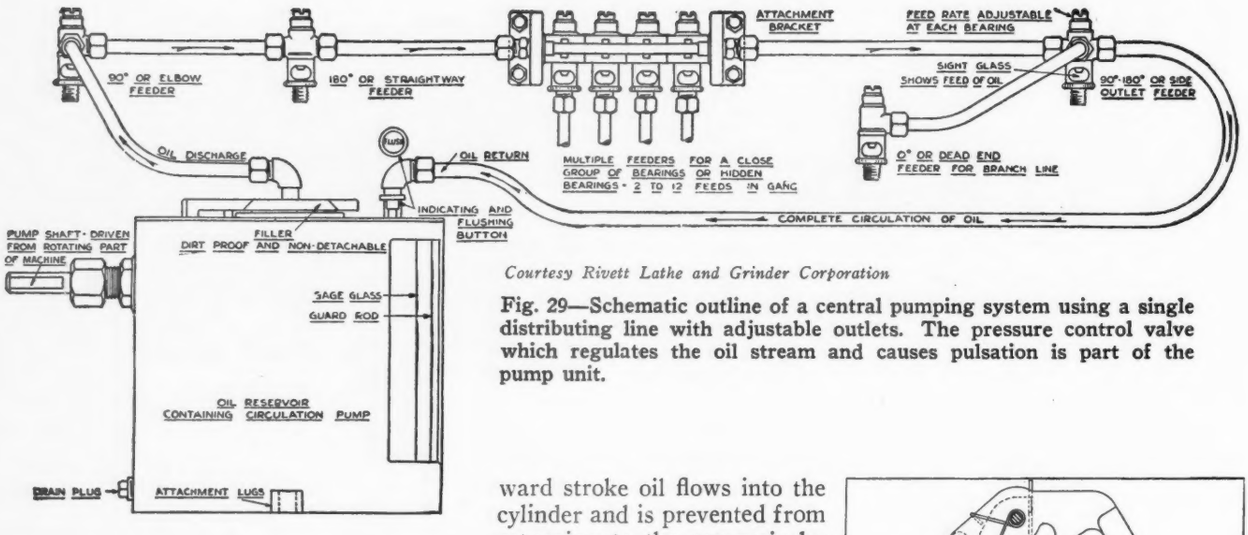
Applying pressure on this button depresses the spring in the relief valve, thus increasing the flow of oil to the bearings. On relieving the pressure the system returns to its normal adjustment for another cycle.

Individual feeders, sections of which are shown in Fig. 30, are provided at each lubrication point. They are of various external forms to facilitate application and piping as shown in Fig. 29.

It will be seen that oil flows through the passage *B*, which is a part of the oil circulating line, under a low pressure excepting when the pulsating action occurs.

An increase in pressure acting through the passage *J* is sufficient to lift the needle *C* from its seat against the loading of the spring *D*, permitting a particle of oil to escape. Upon the passing of the pulsation the valve instantly reseats.

It is seen that the oil thus liberated flows down through the passage *F* and drips off the nozzle *G*. At this


ATTACHMENT BRACKET
FEED RATE ADJUSTABLE AT EACH BEARING
90° OR ELBOW FEEDER
180° OR STRAIGHTWAY FEEDER
SIGHT GLASS SHOWS FEED OF OIL
90°-180° OR SIDE OUTLET FEEDER
OIL DISCHARGE
OIL RETURN
MULTIPLE FEEDERS FOR A CLOSE GROUP OF BEARINGS OR HIDDEN BEARINGS - 2 TO 12 FEEDS IN GANG
0° OR DEAD END FEEDER FOR BRANCH LINE
INDICATING AND FLUSHING BUTTON
COMPLETE CIRCULATION OF OIL
PUMP SHAFT - DRIVEN FROM ROTATING PART OF MACHINE
FILLER DIRT PROOF AND NON-DETACHABLE
SAGE GLASS
GUARD ROD
OIL RESERVOIR CONTAINING CIRCULATION PUMP
DRAIN PLUG
ATTACHMENT LUGS

Courtesy Rivett Lathe and Grinder Corporation

Fig. 29—Schematic outline of a central pumping system using a single distributing line with adjustable outlets. The pressure control valve which regulates the oil stream and causes pulsation is part of the pump unit.

point it is visible through the sight glass *H*.

By turning the adjusting screw *E* to the right or left the load on the spring is varied to give the desired flow of oil for any particular bearing. Feed as low as two or three drops per hour and as high as a small stream at each pulsation may be obtained.

Taking the oil out at the top of the line permits particles of dirt or foreign matter to continue on back to the reservoir where they are filtered out.

As these feeders are of the gravity nozzle type, this system, according to our classification, might be grouped under gravity systems. It is treated here, however, because it functions also as a force-feed system. In case the bearing becomes clogged, the oil backs up in the sight feed and the pressure of the impulse is delivered directly to the bearing.

Where the intermittent application of a heavy oil or grease will suffice, a central, hand- or foot-operated pressure system may be used. Such systems have been employed for chassis lubrication for some time and are now finding their way into the field of industrial machinery.

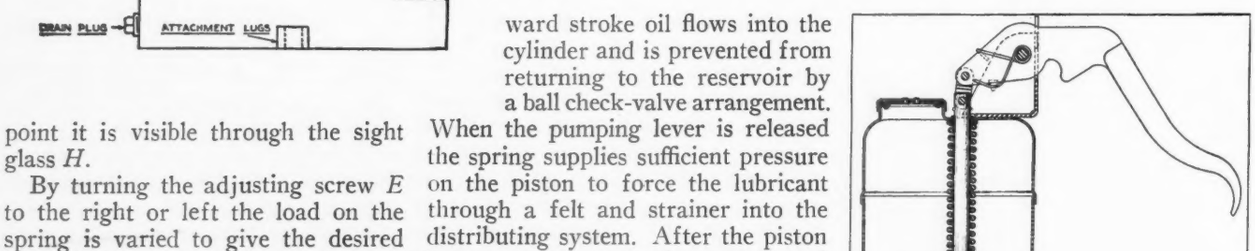
Some form of flow regulation is always necessary with a central pump or compressor, as the grease pumps are sometimes termed, because the lubricant tends to flow through that part of the system having the least resistance. Equipment embodying this feature is shown in Fig. 31. The compressor consists of a pump installed in a reservoir so that the cylinder is primed by atmospheric pressure on the oil.

Pressing the hand lever raises the piston and compresses the spring which acts upon it. During the upward stroke oil flows into the cylinder and is prevented from returning to the reservoir by a ball check-valve arrangement. When the pumping lever is released the spring supplies sufficient pressure on the piston to force the lubricant through a felt and strainer into the distributing system. After the piston has come to rest further seepage of oil into the system is prevented by the check valve.

A single pipe line with the necessary branch lines conveys the lubricant to the bearings. Metering devices or outlets, as shown in Fig. 32, are installed at the end of each branch line at the point where it enters the bearing.

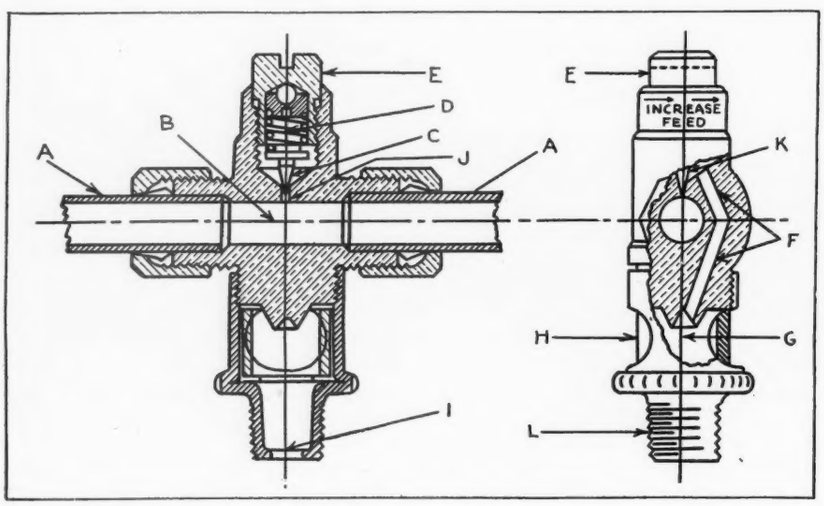
Oil entering this fitting first passes through a filter pad and thence around the pin to the valve at the bottom, which opens under the pressure of the oil, permitting it to flow into the bearing.

In this system the flow of oil may be adjusted from one drop to each stroke of the piston, to as many as are desired for any particular bearing. Adjustment is accomplished by installing pins of various sizes, thus increasing or decreasing the clearance



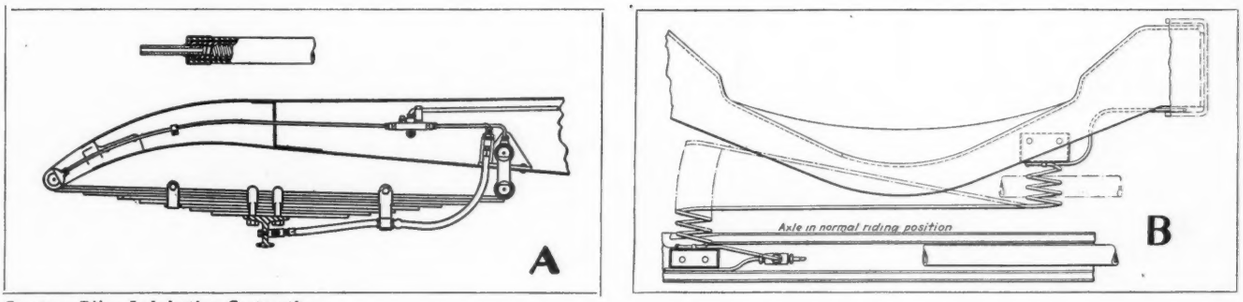
Courtesy Bijur Lubricating Corporation

Fig. 31—A central, hand- or foot-operated pressure system. The compressor consists of a pump installed in a reservoir. The cylinder is always primed.



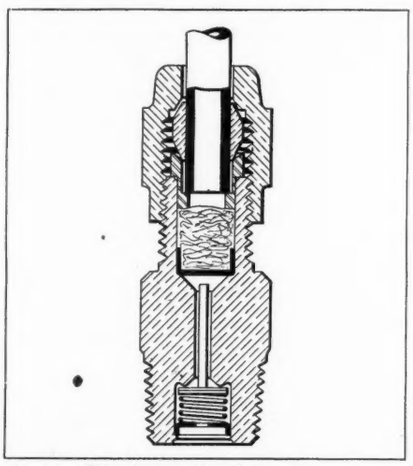
Courtesy Rivett Lathe and Grinder Corporation

Fig. 30—Sectional views of individual feeders used with the single-line pulsating system.



Courtesy Bijur Lubricating Corporation

Fig. 33—Two methods of obviating destructive vibration. In *A* flexible tubing is shown; in *B* coils have been used for the protection of the tubing.



Courtesy Bijur Lubricating Corporation

Fig. 32—Metering device, or outlet fitting, used in conjunction with the lubricator shown in Fig. 31, which controls a filtered supply of lubricant to the bearing.

between the pin and the wall of the passage, through which space the lubricant must flow.

As the pressure diminishes the valve in the outlet closes, thus preventing the oil from running out of, or air getting into, the line. This action is an important feature in these central systems as it would be impossible to meter the oil with the pipes partly filled with air.

Although any kind of pipe that will stand bending may be used as the leads for these central systems, copper or brass tubing is most commonly used, because it is easily bent and fitted into place. Leads subjected to oscillation or vibration may be protected by coiling the tubing or by using flexible tubing. Fig. 33, *A* and *B*, show both applications on an automobile chassis.

An important feature is the method by which foreign matter is excluded from all working parts. Not only is foreign matter injurious to the bearings but, because of the small clearances employed, it would affect the metering of the lubricant.

Prospects Bright for Industrial Congress at Cleveland

MAINTENANCE sessions are to be three in number at the Second National Industrial Congress, featuring Management, Maintenance, and Materials Handling. The congress is to be held in Cleveland, April 13-18, at the Auditorium.

L. C. Morrow, editor of *Industrial Engineering,* who is responsible for the maintenance sessions, announces that definite arrangements have been made for the following papers:

Maintenance of an Industrial Illumination System, by R. C. Smith, Illumination Standards Department, Western Electric Company.

Variations in Maintenance Costs and Procedure, by E. V. Stoody and G. I. Ross, MacDonald Bros., Inc., Boston, Massachusetts.

Maintenance on the Incentive Basis, by W. G. Uhlir, consulting industrial engineer.

Industrial Plant Housekeeping, by W. H. Shipman, Babcock & Wilcox Company.

Tools for the Maintenance Engineering Departments, by an engineer of the National Cash Register Company.

Maintenance Painting, by T. J. Maloney, New Jersey Zinc Company.

Maintaining the Lighting System, by Walter Sturrock, Illuminating Engineer, Nela Park Engineering Department, General Electric Company.

These papers are to be supplemented by others of an equally high standard.

An active Manufacturers' Committee is functioning in Cleveland on matters pertaining to program, inspection trips, and entertainment under the leadership of E. T. Bennington of the Cleveland Crane and Engineering Company. A General Arrangements Committee, headed by C. M. Wilkinson, consulting engineer, is co-ordinating the work of the several participating societies.

Arrangements are being made to accommodate the exhibits of 150 companies who will display equipment directly connected with management, maintenance, and materials handling.

All meetings of the engineering societies will be held in the Auditorium, the same building in which the exposition will be housed.

Midwest Power Conference and Exposition

A CONFERENCE on power and an exposition of power machinery significant because of existing economic conditions will be held in Chicago February 10-14. Participating in the activities are the Midwest Power Engineering Conference, the National Fuels Division of the American Society of Mechanical Engineers, and the Midwest Engineering Exposition.

Managers of the exposition report that approximately 200 manufacturers of power machinery and appliances have taken space, and that the 85,000 sq. ft. of the Coliseum will be filled.

QUESTIONS *and* ANSWERS

Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used.

Rewound D. C. Motor Operates at Half Speed

We have a 500-volt, 50-hp., Westinghouse type S No. 10, 825-r.p.m., d.c. motor; the markings on the commutator end of the shaft are: No. 365913—35754—135B—No. 10—S. This motor has four shunt and four series fields. The shunt and series field coils are connected for our line voltage of 250 volts. Recently the armature was rewound, but when it was stripped we failed to check certain connections to the commutator. When reassembled the motor ran at about half speed. So far as I know the turns, size of wire, coil throw and lead throw are the same as before and I should like to know where our mistake is and how to remedy it so that we can obtain the full speed again.

Carteret, N. J. W. C.

Corrosion of Water Pipes

We are having considerable trouble from the rapid rusting out or clogging of the galvanized pipe used in some of our water lines. So far we have used ordinary galvanized iron pipe obtained from a local plumbing supply house. Most of the trouble is experienced with the ¾-in. and 1-in. lines that supply individual machines. We have both hot and cold water lines. The hot water lines seem to deteriorate faster than those carrying cold water. Accurate records of replacements have not been kept, but it appears that the average life of the smaller sizes of pipe is from one and one-half to three years.

We do not want to incur the expense of installing brass piping throughout, and I am wondering if there is available any kind of pipe, possibly made from some new iron alloy, that is intermediate in cost and has corrosion-resisting properties between brass and galvanized iron pipe. Can readers enlighten me on this subject?

New York, N. Y. W. A. M.

Eliminating Explosion Hazard in Cleaning Motors

We clean our motors by placing them under a galvanized-iron hood connected to an exhaust fan and blowing gasoline into every nook by compressed air. The spray hood is large enough to take a 150-hp. motor. The gasoline is not very finely atomized, as the purpose is to flush out the dirt, and we use about 3 gal. in five minutes. There have been no accidents, but are always afraid that a spark may ignite the gasoline vapor. We have considered the us of a nonflammable liquid such as carbon tetrachloride, but it is too expensive. A mixture of carbon tetrachloride and gasoline has been tried, but they are not permanently miscible. Havy any readers met a similar problem and found a satisfactory way to eliminate the explosion hazard?

Massena, N. Y. R. O. K.

I BELIEVE that if R.O.K. would use carbon tetrachloride, straight—not mixed with gasoline—and give one or more motors a thorough cleaning, he would soon begin to doubt whether it is too expensive to use. Our experience with carbon tetrachloride as a cleaner for dirty motor windings has been very successful.

It is true that approximately $1 a gallon is expensive for such a cleaner, but the benefits and the safety defray that. We have learned from experience that a motor having a good winding, electrically speaking, but dirty and greasy, can be cleaned with carbon tetrachloride so that it will take a new coat of insulating varnish or paint, and be almost equivalent to a rewind job. It usually requires from 2 to 5 gal. to clean motors up to and including the 50-hp. size. I remember only one time when as much as 15 gal. was used. That was on a 100-hp. motor that was in extremely bad condition, but it was a real job when completed. The motor is still in service and, no doubt, will be for many months to come. The $15 which that job cost us is nowhere near what it would cost to rewind that motor and I feel that it was money well spent.

There is no danger of fire or explosion when using carbon tetrachloride, and if a hood equipped with exhaust is used there should be no objectionable fumes.

T. O. ENGLISH.
Electrical Engineer,
Alcoa Ore Company,
East St. Louis, Ill.

WE have been successfully using "Stanisol", a product of the Standard Oil Company, for two years. We use a spray gun made of a ⅜-in. tee and ½x⅜-in. nipple as the outlet nozzle. The opposite end of the tee is brushed to ⅛ in. with a valve between it and the air hose. The bottom of the tee, or suction intake, is of ⅛-in. pipe with a valve between it and a 6-ft. length of ⅜-in. hose. This allows the can of cleaner to rest on the floor and the operator can give all his attention to cleaning. We use the same gun for insulating varnish.

Letting the armature run at high speed in a lathe will expel any cleaner that seeps between the laminations. After using "Stanisol" it is necessary to dry the armature or stator in a warm place. The hazardous properties are similar to those of kerosene and the insurance rates will apply accordingly.

Chief Electrician O. L. ANDERSON.
Cereal Products Company
Manitowoc, Wis.

USING the fan as an exhauster might prove disastrous should circumstances provide an explosive mixture and a spark, such as could result from the fan blades striking some loose object.

The thing to be feared from the use of the apparatus described is ignition at the place where the gasoline-air mixture is discharged to the atmosphere. Should this happen, the flame would be

propagated back to the cleaning hood and an explosion follow.

The foregoing is contingent, of course, on the presence of an explosive mixture, which is of rather narrow limits, say 1.5 per cent to 6 per cent of gasoline vapor by volume.

The use of flue-gas instead of air would make the operation quite safe. The gas should be taken from the chimney and cooled by passing it through a water spray on its way to the fan. Should there be no flue-gas available from an existing furnace, a stove might be installed to furnish the gas, the fuel being wood, coal, oil, or gas. The only precaution necessary is to regulate the air supply so that the oxygen content of the combustion gases does not rise above 16 per cent.

C. O. SANDSTROM.

Los Angeles, Calif.

FOR cleaning 300 or more motors yearly, out of more than 1,300 installed, the following method is used at Plant No. 7, of the Owens-Illinois Glass Company. Incidentally, we plan to give each motor a thorough overhauling every three years.

Routine cleaning involves disassembling the motors, compensators and other equipment, testing for insulation resistance, and then blowing out with live steam at 70 lb. per sq. in. pressure, delivered through a 1-in. nozzle. The motor or other apparatus is then put in an electrically heated drying oven and baked for approximately 24 hours. After this treatment, if another insulation resistance test indicates complete drying, the motors are painted and reassembled.

Although the use of live steam on electrical equipment may seem questionable, we have used it on 220-, 440-, and 2,200-volt equipment for ten years or more without one failure traceable to the method of cleaning.

If a motor must be returned to service at once we use gasoline for cleaning it; when the use of that material would be extra-hazardous owing to the location, we employ carbon tetrachloride.

Thorough drying after the steam bath, and checking the insulation resistance to ground, are essential to the success of the live-steam method of cleaning.

Alton, Ill. L. E. BENEZE.

USING gasoline instead of nonflammable carbon tetrachloride is, it seems to me, an expensive economy. In the first place, gasoline wastes faster through evaporation, and insurance premiums are always higher than when a non-flammable cleaning fluid is used.

To my mind it is also poor practice to depend solely on the force of the air and gasoline to dislodge dirt. When a motor is first disassembled as much of the dirt as possible should be removed with a blunt knife before turning on the air gun. When using the gun work the dirt loose with a paint brush.

If gasoline is used the necessary safety precautions are to see that the steam pipes are kept away from the galvanized iron hood, and that the hood is vented to the atmosphere so that no sparks from nearby chimneys can fall into it. Attach the hood to a permanent ground. Collect in a drain pan all drippings from the motor that is being washed. Keep the surroundings clean and free from oil and flammable material. Arrange the cleaning room so that the operator will not be trapped in case of accident. An extinguisher for gasoline fires must be kept in a convenient location. An induction motor with no current-breaking connections should be used to drive the fan. Ground the motor frame thoroughly.

Denver, Colo. CARL A. WAGNER.

Cause of Hot Armature Bearings

Out of about 700, 135-hp., 600-volt, street railway armatures there are two that give us much trouble due to repetition of certain defects—badly worn or hot armature bearings. These two armatures are never replaced in the same motor shells, and we have inserted new shafts, put in new coils, balanced them, and so on, but can not overcome the difficulty. These defects have continued over a period of seven years, and we can average only 1,000 car-miles per defect. What is causing this trouble, and how can we cure it? C. S.

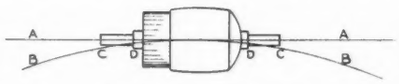
Upper Darby, Pa.

A SPRUNG shaft or an improper relation of the armature to the center line of the bearings on the armature shaft will cause the trouble.

In one case, after a new shaft had been pressed in an armature, bearing trouble was experienced, which was traced to a sprung shaft. This case is illustrated by means of the accompanying sketch. The center line AA represents the shaft as it should be, whereas line BB, although somewhat exaggerated in the drawing, represents the condition found.

After being finished in the lathe the shaft was checked with a lathe indicator and found to be true, after which the keyway was cut in the shaft to correspond to the armature spider. The shaft was then pressed in place.

Apparently, the cutting of the keyway caused the shaft to be sprung. Its condition was not discovered even after checking the assembled armature between centers for the reason that the operator placed the indicator at the points C-C, the extreme ends of the shaft. Readings taken later at point C-D and D-C revealed the true condition, wherein the bearing surface in the bearing was near the outside end. And since the bearing surface was reduced, the pressure was increased beyond the allowable working pressure per inch of



Cutting a keyway in a shaft caused it to be sprung out of line as indicated by the line BB. Although exaggerated, it shows the direction of the distortion.

projected area. Straightening the shaft corrected the trouble.

If the armature does not bear the correct relation to the shoulder on the shaft at the bearings, the float will be in one direction, with the result that the end pressure will cause excessive heating. Increased temperature means increased shaft expansion and if the housing resists the expansion of the bearing, the bore will be reduced. This condition reduces the oil-film clearance, promoting in turn, increased friction, higher temperatures, further expansion of the shaft, contraction of the bore until the bearing finally seizes.

It is suggested that the shaft be checked for straightness and the relation of the armature to the shoulder on the shaft as compared to other armatures in service. Also, observe the direction of float when it is in position.

Engineer,
Cutler-Hammer,
Milwaukee, Wis. E. H. LAABS.

Power Factor Rating of Synchronous Motors

I have been investigating the use of synchronous motors to improve our plant power factor, and have been somewhat puzzled by the fact that these motors may be rated 80, 90, or 100 per cent power factor. It will be very helpful to me if someone will explain just what this rating means and how it affects the choice of synchronous motors for power factor correction. If we decide to buy such a motor, how can I tell whether to use, say, an 80 per cent, or a 100 per cent power factor machine?

Baltimore, Md. **B. G.**

ONE must keep in mind the fundamental fact that the power-factor-corrective ability of a leading-power-factor motor is in inverse ratio to the power-factor rating. In other words, as the power-factor rating goes down, the corrective ability goes up. The amount of correction required in a specific plant determines the power factor of the motor which is to be installed.

Power factor is the ratio of the kilowatts to the kilovolt-amperes. In solving the problem of power-factor correction, it is necessary to divide the kilovolt-amperes into two components. One is the power component, or kilowatts, which does the actual work; the other component is the magnetizing or reactive kilovolt-amperes, which is a pulsating power and does no work.

When a unity-power-factor motor is installed, it raises the plant power factor because it adds to the kilowatt load, but does not change the reactive kilovolt-ampere load. This solution is suitable only where the required amount of correction is small.

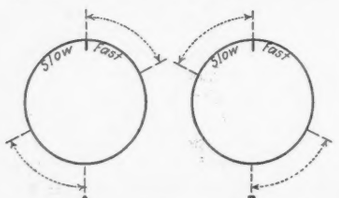
On the other hand, a leading-power-factor motor helps to correct the plant power factor in two ways: (1) It adds to the kilowatt load. (2) It subtracts from the reactive kilovolt-amperes. The lower the power-factor rating of the motor, the more it will subtract from the reactive kilovolt-amperes. Hence, it can readily be seen that a leading-power-factor motor is much more efficacious in correcting power factor than a unity-power-factor motor.

OTTO R. HEIDELBERGER.

Electrical Engineer,
Electric Machinery Mfg. Company,
Minneapolis, Minn.

What Is Wrong with This Synchroscope?

We have had a G.E. M 3 synchronism indicator in use for six years that has recently given trouble. Our power supply consists of one 750-kva. generator, turbine driven, and one 350-kva., belt-driven generator. Both are 60-cycle, 110-volt machines. When synchronizing, as the incoming machine gets nearly in phase the needle of the indicator



jumps past the center mark on the dial. When the incoming machine is slow the needle swings as shown in diagram A; when the machine is fast the needle takes the position indicated in diagram B. It makes two jumps per revolution. I have connected a 50-watt, 250-volt lamp in series with the indicator resistance and the needle does not now jump so fast; the movement from the spaces shown in the diagrams is much slower, but still faster than elsewhere on the dial.

I shall appreciate it if someone will tell me how to remedy this trouble. A. H.

Selma, La.

ERRATIC action of a synchroscope may be caused by a combination of friction, sticking of parts, partial shorts or partial opens. The instrument should be carefully cleaned and examined, as dust or dirt may be causing the trouble. If the cause does not become apparent on this examination, the instrument will have to undergo a thorough test.

Sometimes the trouble mentioned is due to inequality of the split-phase currents, which will cause the needle to travel around the dial in a very peculiar manner.

The currents in the inductive and non-inductive circuits should be equal, as shown by an a.c. milliammeter connected in series with each circuit.

First measure the current in the non-inductive circuit at normal voltage and frequency; then measure the current in the inductive circuit under the same conditions. If the current in the inductive circuit is too high, insert more iron in the impedance coil, or close the gap; if it is too low, remove some iron or open the gap.

My experience with this class of instruments shows, however, that it is preferable to send the instrument back to the maker for repairs, if one is certain that the trouble is not external and cannot be corrected in the shop.

If an electrician is allowed to tinker with these instruments it is invariably necessary to send them to the factory in the end, as considerable skill and special training are required before a man becomes proficient in making instrument repairs. LEE F. DANN.

Electrical Superintendent,
Donnacona Paper Company, Ltd.,
Donnacona, Que., Canada

THE sypmtoms given agree almost exactly with one that came to the writer's notice some years ago. This particular synchroscope would not give an indication when the machine was in phase.

The needle would stop just before the top point was reached and then go past the mark, "like a scared cat," as one man remarked. The writer was a relief operator and seldom had need to use the instrument, but one night decided to investigate the difficulty. After taking the glass cover off the trouble was very evident. The white dial of the instrument was warped and the needle was rubbing.

The needle would hit the dial and then stop until the machine was out of phase long enough to give the necessary torque to pull it loose; then it would jump.

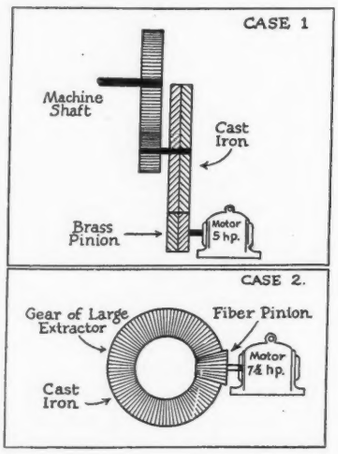
I think that if A. H. would investigate this he might find the difficulty. Moving the needle out from the dial enough to clear, or the installation of another dial, would remedy his trouble.

CHARLES O. RANKIN.

K. W. Manufacturing Company
Ontario, Calif.

How to Increase the Life of These Pinions?

Case 1: The brass pinion does not hold up at all, and makes a lot of noise. Apparently motor does not have end play.



Case 2: The fiber pinion wears out quickly. Alignment checks up O.K. Motor has ⅛ in. end play.

Can I get longer life from pinions made of other materials? If materials are not at fault what does cause these pinions to wear? S.P.W.

Woolrich, Pa.

DATA given are too incomplete to permit much more than a guess at the cause of the trouble; it might be found, if the speeds and sizes of the gears were given, that they are too small for the load, which would, of course, explain the situation.

Aside from this, in Case 1 brass is not a very good gear material for wearing qualities or noiseless operation; probably better results would be obtained by using a micarta spur pinion and cast-iron spur gear in place of the herringbone type.

My own experience has been that unless herringbone gears are very carefully cut and exactly mounted they wear badly and are not so good as high-grade spur gears.

In Case 2, the ⅛-in. endplay of the pinion would change the tooth contact so that it would not give the rolling contact that teeth should have, except for a very small fraction of time, and excessive wear would naturally be expected. It also seems likely that with the pinion mounted directly on the motor shaft, the speed might be excessive except for gears cut with more than commercial accuracy.

If the speed is not too high it might be possible to obtain better results by driving from the motor through a belt or flexible coupling.

Plant Engineer, H. D. FISHER.
New Haven Pulp and Board Company,
New Haven, Conn.

(Continued from page 82)

tinuity of the flow of materials through the factories?

The production machines must operate. It is the plant engineer who anticipates breakdowns and insures the management with a factory running at highest efficiency.

K. D. HAMILTON, *Mechanical Department*
Geo. E. Keith Company
Campello, Brockton, Mass.

Should Maintenance or Production Department Control Cranes, Elevators, and Trucks?

(Question Presented in the April Issue)

WITHOUT doubt trucks, cranes and elevators should be handled by the maintenance department. I have found by experience that the operating department does not look after them properly.

Large fleets of trucks, both auto and electric, should be placed under control of a truck superintendent responsible for their upkeep. They are issued out on written order stating where they are going, probable length of trip, etc. Mileage will be taken and supplies of gas and oil noted, so that records of performance can be kept.

In the case of electric trucks, caterpillars, or crawlers, the operator will come under the maintenance department (truck superintendent). He will, of course, be routed in this work by the department for which he is hauling, but no one except the regular operator will handle the truck.

I have had cranes handled both ways and ended up with them under the maintenance department. Where the cranes, both railroad type and traveling, were tended by the production or operating departments, the maintenance department was called in as a last resource or in a repair capacity to overcome abuse.

I took these cranes, put in men who understood them, paid them a little more perhaps, but made them responsible for the crane and its upkeep. They took their routing instructions from the operating department, but all repairs were made on their request to the machine shop foreman. The latter also made a periodical inspection, accompanied by the chief electrician or deputy when power was used.

Under the operating department we found little or no inspection made, any odd man was often put to run them, and no record was kept of cleaning boilers, or inspecting cables and operating mechanism.

At first, after the change, there was friction concerning overloading, but when it was understood that the operator was a responsible individual who knew the capacities of his equipment this was overcome.

In my opinion elevators naturally come under the maintenance department, that is, a maintenance department man will operate them. Service is under the department for which the elevator is functioning. Inspection is made weekly by the chief electrician and machine shop foreman. The operator is expected to maintain running condition, if he can. However, lubrication and overhead repairs and inspection are taken care of by a special man, if there are enough elevators to warrant this procedure. Otherwise, provision is made for a man from the machine shop to inspect the mechanical equipment before starting in the morning and at noon.

In the case of bucket elevators especial attention is paid to loose bolts and condition of buckets, with a supply maintained to replace broken ones. Chain upkeep is to be taken into consideration.

Repairs of elevators, especially of the chain type, when they are bad are expensive, and mean considerable time lost. A stock of links, pins, shafts, and sprockets should be on hand ready to put in, and where would they be but in the maintenance department?

I am not antagonistic to the production end of the plant, but am firmly of the opinion that the less it goes outside its own province the greater is the general efficiency of the plant. The maintenance department does not attempt to say how to produce, but maintains (and sometimes supplies) the wherewithal for production.

M. C. COCKSHOTT
J. B. Gill Corporation, Long Beach, Calif.

AS a general rule, the men who operate the cranes, elevators and trucks are not mechanically inclined, and are not interested in keeping the equipment they use in proper working order. To illustrate:

A ten-ton elevator, operated from a controller in the cab, was installed and one man on each shift was instructed in the proper method of operating, the load to be carried, and the method of placing the load. Within a week it was noticed that the elevator was running without an operator. It was found that the operator was plugging the controller handle, which normally flew back into the off position as soon as the handle was released. The slow speed allowed the operator to start the elevator and jump off the platform. Warning was given, but in two weeks the man had to be discharged.

In another instance one of the storage battery trucks was found to be practically dead three mornings hand-running. This truck was operated during the daytime only, and was put on charge at five each evening. It was found that two men from another department were using the truck for joy-riding around the shipping department, there being ample space for a race track, as the floor space occupied 50,000 square feet.

In the cases cited the offenders belonged to the production end of the plant, and it was the maintenance department which had to bear the brunt of the work in repairing the damage.

The production foremen are more interested in getting out big production in short time and have little time to inspect elevator gates and cables, crane cables, and truck batteries. Crane and elevator cables require systematic and regular inspection, which should be carried out by men who have had the experience that equips them to detect faults.

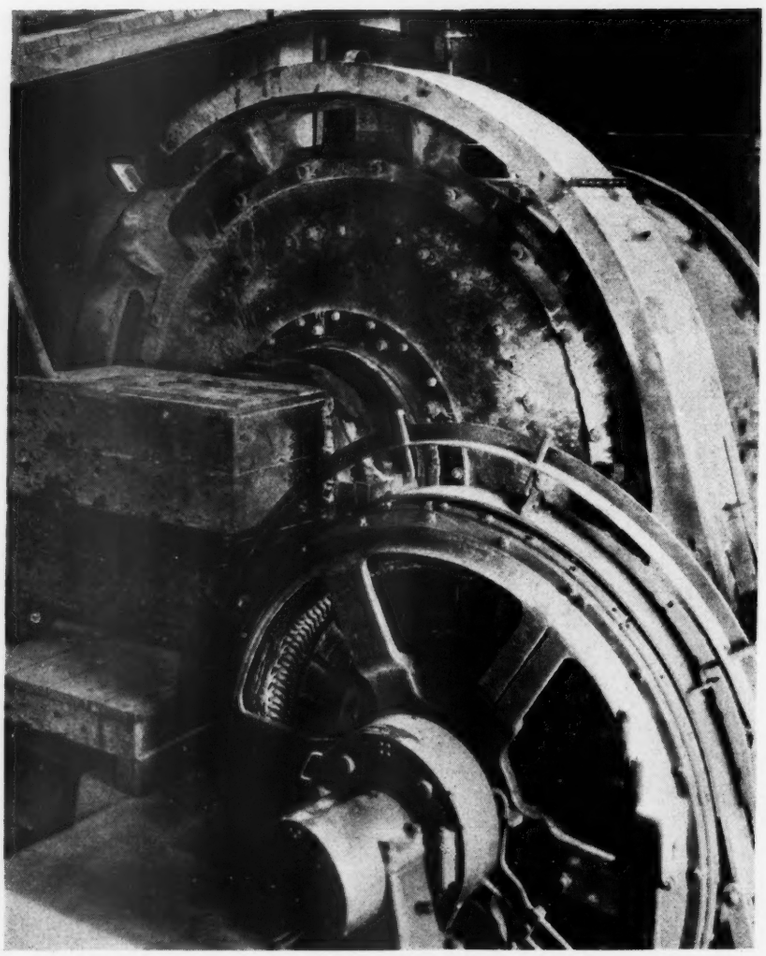
Since modern materials handling equipment, such as cranes, hoists, storage battery trucks, and elevators, are electrically operated, many troubles and replacements are the responsibilities of the electrical department, but such items as worn cables, sheaves, drums, gates, etc., should be handled by the mechanical department. Of course there should be full cooperation between the two.

H. E. STAFFORD, *Electrical Engineer*
Port Arthur, Ontario

Motors for High Inertia Loads

Part 1

By R. F. EMERSON
Industrial Engineering Department
General Electric Company
Schenectady, New York



Because the super-synchronous motor is synchronized before the mechanical load is started, it may be applied to loads having high starting torques. Its speed is fixed and its efficiency and power factor are high at all loads.

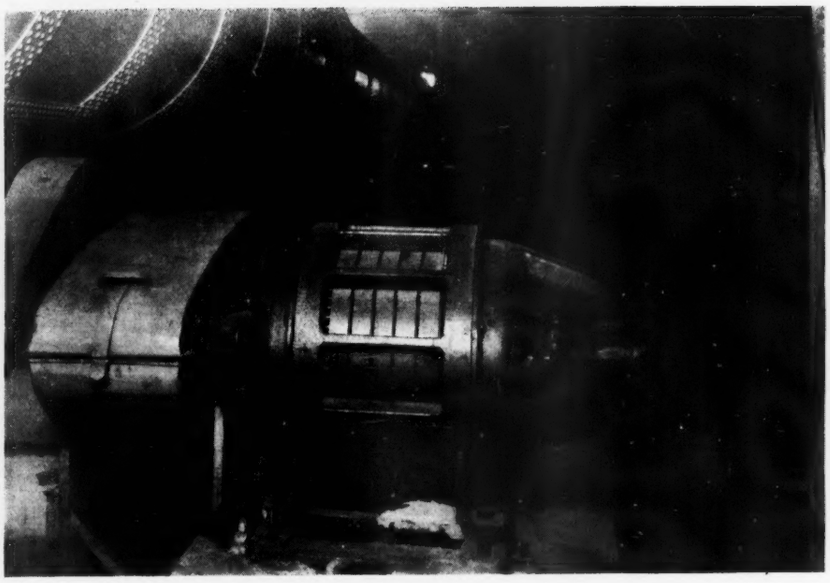
BEFORE applying a motor to any drive it is desirable to analyze the character of the load in its component parts, because this often has an important bearing on the type and size of the motor required. There are three types of loads which may be listed as follows:

1. Friction (including static friction and windage.)
2. Gravity.
3. Inertia or flywheel effect.

In most installations alternating current only is available, so a.c. motors only will be considered. Direct-current motors must always prove their case before being applied owing to their higher cost, also the additional cost of rotary converters or m.g. sets.

Certain kinds of machines can be cited as examples of drives where one or more of the above characteristics have a preponderant effect, although all drives to which motors can be applied will usually have all three of these types of loads to a greater or less extent. For example, a long belt conveyor with a large number of idlers supporting the belt or a screw conveyor, conveying powdered coal or similar material are examples of high friction loads. Such a drive also has a static friction load which exists only at the instant of starting and disappears after the equipment is in motion and a film of oil has covered all the bearings.

An example of the second type of load is that of an unbalanced hoist raising a load vertically; a load where the power demanded of the motor is



Inherent characteristics of the slip-ring motor make it adaptable for use in driving loads of exceedingly high inertia. Kiln drives rightly belong in the field of the wound-rotor motor because of the high inertia to be overcome in starting.

mostly required to overcome the pull of gravity, and a smaller proportion is absorbed in the friction of the hoist gears, reeving of the hoist cables in the sheaves, etc. If the load is being lowered, then the force of gravity assists the motor. If it is greater than the friction load, it will overhaul the motor and cause it to overspeed or act as a brake, depending on the characteristics of the motor and the type of the control employed.

Owing to the necessity for a considerable amount of low torque and reduced-speed running, a wound-rotor induction motor, with secondary resistor and drum controller or a master switch is ordinarily used.

In driving machines such as punch presses, hammer mills, counterweighted hoists, mine fans, shears, etc., having a large amount of inertia or flywheel effect, which is sometimes termed WR^2, a variety of types of a.c. motors have been used.

In the case of all these types of machines, their inertia is a detriment during the acceleration period because it prolongs the time of acceleration. In the case of equipment driven by squirrel-cage or synchronous motors which take high inrush currents at starting, too long a period of operation at reduced speed may injure the motor. During this period of acceleration extra power is required of the motor, over and above that required to overcome friction and gravity. This extra power is called the force of acceleration and it disappears after the equipment is up to speed.

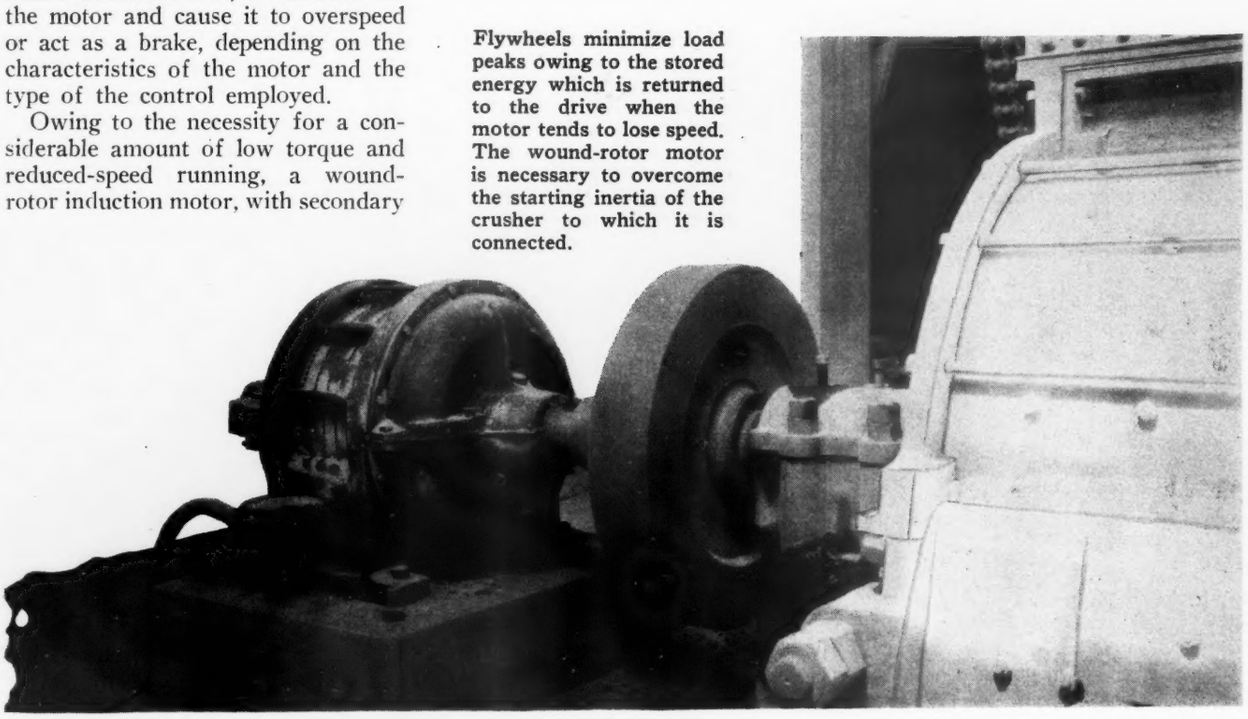
A punch press or a shear will be equipped with a heavy flywheel purposely to increase the inertia or flywheel effect. The extra energy which is expended during the period of acceleration is not entirely lost, but is merely stored in the flywheel, ready to help the induction motor furnish the required power.

There is a variety of types of hammer mills, crushers and pulverizers, all of which seem to impose a more or less high inertia load on the driving motor during the acceleration period. The squirrel-cage motor, the wound-rotor induction motor, the synchronous motor, and the supersynchronous motor have all been used in driving the various types of equipment mentioned.

The squirrel-cage motor is the least complicated of the four types under consideration. Its control may be designed for starting the motor on full voltage, non-reversing.

When peak loads are thrown on the motor, its slip or tendency to slow down with increasing load enables it to take advantage of flywheel effect, thus reducing the maximum

Flywheels minimize load peaks owing to the stored energy which is returned to the drive when the motor tends to lose speed. The wound-rotor motor is necessary to overcome the starting inertia of the crusher to which it is connected.



power demand. Another characteristic of the induction motor is the cushioning effect which reduces the shock to the mechanical equipment and to the motor itself.

Owing to the high inrush current of the general-purpose, squirrel-cage motor, care should be taken in applying it to crushers having high flywheel effect. Since the inrush current is often seven or eight times the full load current, the acceleration period should not be prolonged beyond the time period recommended by the motor manufacturer. In cases where the crusher has a high flywheel effect, and it is still desired to use a squirrel-cage motor, it is possible for the motor manufacturer to furnish a squirrel-cage motor with a high-reactance rotor winding, so that the starting current is materially reduced. This change in motor design should be considered before over-motoring the crusher. An over-size motor may accelerate the load in a shorter time, but it will continue to run under reduced loads. Consequently, the power factor will be materially affected.

The squirrel-cage motor has been successfully applied to many crusher and pulverizer installations where the flywheel effect of the driven machine is such that proper starting can be accomplished without over-motoring.

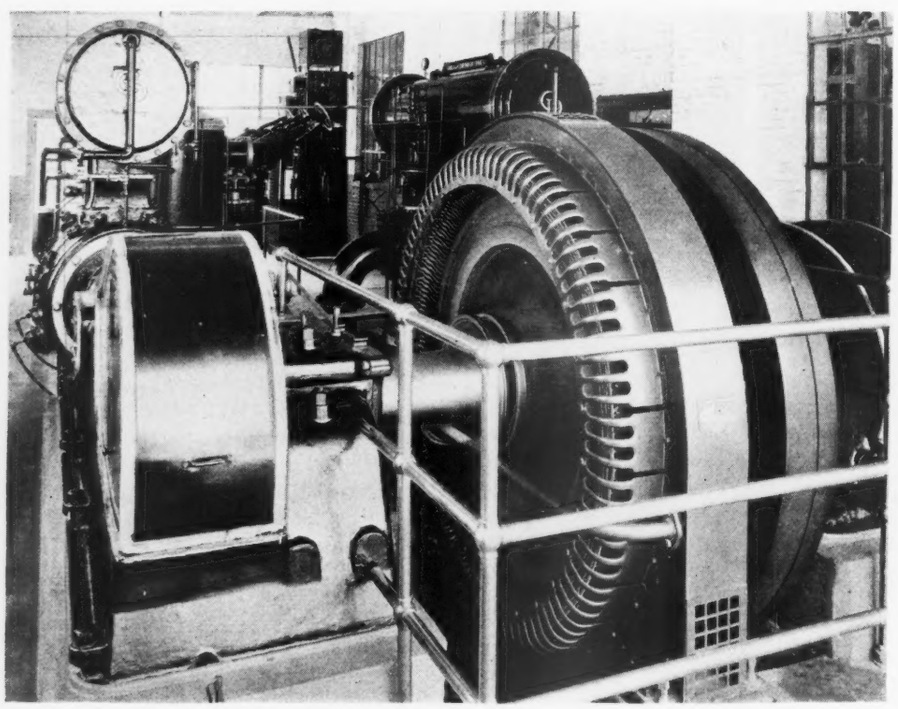
The wound-rotor type of induction motor has the advantage of starting a crusher with comparatively small increments of torque and current peaks as the resistance is cut out of the motor secondary. This characteristic of the slip-ring motor is sometimes quite desirable for starting crushers having high WR^2, in that it is easier on the equipment, and causes less disturbance on the electric supply line. The motor is also capable of exerting practically its maximum torque at starting, which is always desirable when starting high friction loads. As in the case of the squirrel-cage motor, it slows down with increased load, so that advantage can be taken of flywheel effect in minimizing load peaks, thus reducing the maximum power demand.

Standard non-reversing drum control is used unless the quantity of current to be handled calls for magnetic control.

Formerly, the synchronous motor was not considered for any drive unless the required starting torque was low, as in the case of fans, centrifugal pumps, m.g. sets, and compressors equiped with unloaders. Progress in the design of synchronous motors has made it possible to use this type of motor for crusher drives even though the starting torque is considerable. It also has the advantage of high efficiency over a wide load range and it has the inherent advantage of power factor improvement by over-excitation of the field. This type of motor does not have the small air gap inherent in the design of every induction motor, which may be considered of some advantage when located in dusty locations. On the other hand, this type of motor has the disadvantage of requiring d.c. excitation. The use of a d.c. machine should be avoided in exceptionally dusty or dirty locations because of wear of commutators and brushes.

Since the speed of a synchronous motor is fixed by the frequency of the electrical supply, all peak loads are reflected back into the power circuit. As in the case of the squirrel-cage motor, care should be taken in applying the synchronous motor to the driving of crushers and pulverizers having high inertia. The thermal capacity of the amortisseur winding of the standard synchronous motor usually is considerably less than that of the rotor winding of the corresponding squirrel-cage motor, so that there is always the more reason for checking the WR^2 of the driven load. It is, however, possible to design an amortisseur winding to meet starting conditions which are too severe for the standard motor.

The super-synchronous motor is synchronized before the mechanical load is started. Therefore, any part of the pull-out torque can be applied in suitably varying degrees for starting and accelerating the crusher or pulverizer. With the exception of this added advantage, the characteristics are generally similar to those of the synchronous motor.



Improvement in design is responsible for the increasingly wide application of synchronous motors. The compressor is equipped with an unloader to make starting easy; the flywheel delivers or returns its stored energy to the shaft under heavy load conditions.

The Machine Age and Its Consequences

By FRANKLYN HOBBS

Director of Research, Central Trust Company of Illinois, Chicago

THE introduction of automatic and labor-saving tools and appliances into the manufacturing industry has not reduced the amount of money paid to labor by that industry and has not been able to displace workers in certain industries as rapidly as avenues of employment have been opened to them in other industries.

Had there been no time- and labor-saving tools introduced into factories during the last forty years, there could have been no electrical appliances, no telephone, no automobile, no moving pictures, no radio, no airplane; and the lowly cigarette would be beyond the reach of a man of ordinary means.

The introduction of labor-saving tools has made it possible for the ordinary factory worker to live in an atmosphere of comfort which neither George Washington nor King George III ever enjoyed.

	Population of United States July 1	% Employed in Factories	(a) Persons Gainfully Employed	Gainfully Employed % of Population
1899	74,799,000	6%	(b) 29,073,000	39%
1904	82,601,000	7%		
1909	90,691,000	7%	34,255,000	38%
1914	97,928,000	7%	37,782,000	39%
1919	105,003,000	9%	40,282,000	38%
1921	108,197,000	6%	40,819,000	38%
1923	111,511,000	8%	42,156,000	38%
1925	114,826,000	7%	43,844,000	38%
1927	118,141,000	7%	45,747,000	39%
1929	121,455,000	7%		

(a)—Findings of National Bureau of Economic Research. (b)—U. S. Census 1900.

Every industrial man has wondered just how the machine is affecting employment. Here are the facts covering the last 30 years.

True it is that, during the last thirty years, time-saving methods and tools have driven two workers out of every three away from the bench and left the third man drawing just as much pay as the three men had drawn before the tools arrived. The two men were driven from that bench to other benches at an increased wage in every case. It is easy to prove that machinery has thrown thousands of men out of jobs, and it is just as easy to prove that machinery has driven every one of these men into a new job at higher pay. Every man who works in a factory today earns three times the money his father earned for doing the same work at the beginning of the century.

When the twentieth century began thirty years ago this country had a population of 75 million persons and 6 per cent of them were employed in factories. At the beginning of last year this country had a population of over 121 millions and more than 7 per cent of them were employed in factories. It is apparent that the demand for factory workers has increased faster than the population has increased. This increased employment for factory workers must have been directly due to the introduction of machinery in manufacturing enterprise because the gain in factory employment was not so great in any other country on which we have records. With the other countries increased factory employment occurred in proportion to the introduction of improved machinery; thus we have mathematical proof that the introduction of machinery in manufacturing operations has not caused unemployment.

The wage side of the question may be dismissed with the simple statement that the factory worker, when this century began, was earning $426 per year while the factory worker of 1929 was paid $1,318 for his efforts. Factory employment increased 16 per cent faster than population increased, while factory wages increased more than 200 per cent; these statistics answer all questions as to the effects of machinery on employment and on wages.

This brings us to the much discussed matter of whether the worker is getting his share of the pie. The figures already given prove the great gain in employment, and the greater gain in wages, but the worker has been told that, through vast combinations of capital and mass production, the owner is constantly demanding a larger share of the pie. The mathematical facts on this phase of the question are quite convincing. There has been some variation in the por-

Abstract of an address before the Machine Tool Distributors of Chicago.

tion received by the worker and, naturally, a similar variation reversed has operated upon the owner. The average for a period of thirty years ought to be a fairly reliable basis on which to form a judgment. During that thirty years the workers' share of the value added to raw materials through hand and machine work has varied from 36 per cent to 43 per cent. The average for the thirty years has been something over 40 per cent received by the workers and 60 per cent received by the owner.

Whether this division is fair or not, it is just what it has been since consolidation of manufacturing enterprise and mass production with the aid of tools has been in vogue. I submit that an unjust practice is unlikely to continue in a country like ours for a period of thirty years. I believe it fair to assume that labor is entitled to 40 per cent of the value added to raw materials in the process of manufacturing which is just what it has been getting.

There is another angle which is really the most important of all and this figure tells the whole story as affecting capital invested and the effect on labor. I refer to that portion of the actual selling price of the product which goes into the pay envelope of the factory worker. During these thirty years since 1900 the portion of the total value of factory output received by workers has varied from 16 per cent to 18 per cent. In 1899 and 1923 the worker received 18 per cent of the total value of manufactured products. In 1929 the workers received only 16 per cent. In every other year the worker's share has been 17 per cent and the average for the thirty years has been 17 per cent.

The worker was receiving 17 per cent of the total value of the product of the factory thirty years ago and he continues to receive 17 per cent as his share. He was receiving 40 per cent of the value added to raw materials through manufacturing processes and he is still receiving it. There were 4,700 thousand of him at work in the mills thirty years ago and there were 8,500 thousand of him at work in the mills in 1929. Only 6 per cent of the population was required to man the factories thirty years ago and it now requires 7 per cent of the population to do the work.

Going outside of manufacturing enterprise and taking in the whole picture of the country's workers, whether they wear the overalls of the laborers or the shiny office coat or the white collar, we find another fact regarding employment which brings further surprise. A generation ago 38 per cent of the whole population was gainfully employed, and now more than 39 per cent of the whole population is gainfully employed. In order that we may be supplied with goods and services which our present mode of living demands, it is necessary that a larger portion of our population work. In my study of this subject I have concluded that shorter hours and longer vacations are responsible for the gain in the percentage of the population which must work for a living and the gain in the percentage of our population which must man the factories.

If we move further in shortening hours it will be necessary for an additional number of people to don the overalls or the office coat and go to work.

A recent report of Commissioner Ethelbert Stewart, of the Bureau of Labor Statistics, shows figures which disagree with those I have just given you because Mr. Stewart has seen fit to take the period of eighty years from 1849 to 1929. I am uncertain as to just what his figures are intended to prove but I am certain that they did not prove anything of great importance because they make a flying leap from 1849 to 1929 without reference to the intervening trends. I mention this report as I believe it may prove that the introduction of labor-saving machinery was the salvation of the factory worker. If the condition shown by the Bureau of Labor report had not been altered by the introduction of machinery during the last thirty years the factory worker may have found himself at this time in a most unhappy plight.

I want to impress upon you the importance of spreading these facts so that they will reach the eye of every manufacturer, every stockholder in a factory, and every factory worker in this country. When this has been done most of the labor disputes in factories will settle themselves and the labor demagogue who rants about machinery causing unemployment will have to go and find a small hole, crawl into it, and pull the hole in after him.

The machine age has increased employment, increased wages, made work easier, saved lives and limbs, and enabled the working man to live in such comfort and luxury as was unknown to any man on earth when some of us were born.

FACTORY EMPLOYMENT

(U. S. Census of Manufactures)

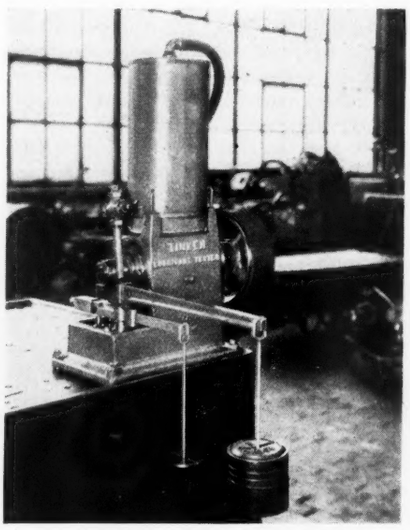
	Total Value of Products	Value Added by Manufacture (000,000 omitted)	Value Added to Material by Each Worker	Number of Workers	Amount Paid Each Worker	Workers Received in % of Added Value	Workers Received in % of Total Value
1899	$11,407	$ 4,831	$1,025	4,713,000	$ 426	42	18
1904	14,794	6,294	1,151	5,468,000	477	41	18
1909	20,672	8,529	1,289	6,615,000	518	40	17
1914	23,975	9,708	1,408	6,895,000	590	42	17
1919	62,042	24,809	2,757	9,000,000	1,162	42	17
1921	43,619	18,327	2,639	6,944,000	1,181	45	19
1923	60,530	25,846	2,945	8,777,000	1,254	43	18
1925	62,668	26,771	3,194	8,382,000	1,280	40	17
1927	62,718	27,585	3,304	8,350,000	1,299	39	17
1929	68,453	31,096	3,637	8,550,000	1,318	36	16

EQUIPMENT NEWS

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.

Timken Lubricant-Testing Apparatus

APPARATUS for testing the load-carrying capacity of lubricants has been announced by The Timken Roller Bearing Company, Canton, Ohio. The equipment is applicable in industrial plants where it is desirable or necessary to determine the efficiency of lubricants for given conditions of service. In addition it can be used to obtain data on the relative efficiency of different bearing metals under various conditions of load, speed, temperature, or with different lubricants.



Essentially, the apparatus consists of a cast-iron base which supports the testing mandrel, two levers and a container holding about a gallon of the lubricant to be tested. The tank is mounted on top of the base, and just under it is an electric heater, used to raise the oil to any desired temperature up to 210 deg. The oil flows from the tank, over the test piece, to a sump in the base by gravity, the rate of flow being adjusted by means of a valve in the line. From the sump, the oil is returned to the tank by a pump belt driven from the testing mandrel. The latter extends through the base and may be either direct or belt driven by a variable speed fractional h.p. motor. The mandrel is mounted in two roller bearings, and is tapered at the test end to receive the tapered cup of a roller bearing. This cup, which forms one of the test pieces, is held in place by a nut on the end of the mandrel.

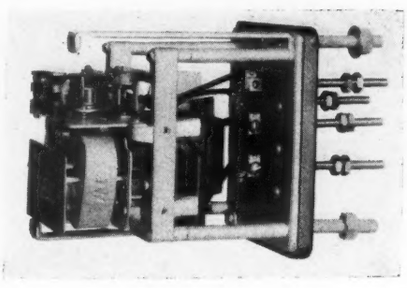
Two levers are used, one above the other. The upper, called the load lever, carries the test block and is pivoted on a knife edge mounted in the lower lever. The latter, called the friction lever, is also pivoted on a knife edge and is provided with a stop at the unloaded end. Thus the test block is always parallel to the revolving cup and the unit loading over the length of both pieces is always constant. The test block is a small piece of metal about ½ in. square by ¾ in. long, hardened to Rockwell C-60 and ground. It is inserted in a notch in the loading lever and held in place by a wedge. The friction lever is provided with vernier scale, and a sliding weight for obtaining accurate measurements, and both levers are equipped with hangers for carrying adjustable weights.

A welded steel housing is provided to cover the end of the mandrel and levers.

General Electric Induction Undervoltage Relay

GENERAL Electric Company, Schenectary, N. Y., announces an induction relay, designated Type IAV, for undervoltage protection of a. c. circuits. It is a single-pole, single-circuit device with circuit-closing contacts, and is applicable to circuits of 600 volts or less and to circuits of higher voltages with the 110-volt secondaries of potential transformers. Units are available for 25- and 60-cycle service.

Contacts are self-aligning, the station member being individually adjustable and the movable member a silver disk which provides different points of contact.



When the relay has operated, a target indicator is visible from the front.

Madison-Kipp Air Filer

AN addition to its line of pneumatic tools, known as the Kipp Air Filer, has been announced by the Madison-Kipp Corporation, Madison, Wis. The tool operates at speeds from 500 to 5,000 strokes per min., depending upon the amount of air admitted by the operator's trigger valve.

Files are held by means of a hand-operated collet at the end of the spindle. Different shaped files are available for various kinds of work. A pistol grip is used which gives the filer a natural position in the hand.

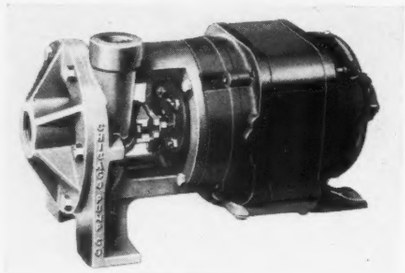
Air, under pressures of from 30 to 100 lb. enters the operating mechanism through an air hose connected to the handle or pistol grip. This air is controlled by a trigger valve which admits air to a rotary valve which is die cast into an air turbine. The position of this valve is always such that the air will first flow to either end of the piston cylinder. This drives the piston forward or backward through half a cycle, uncovering the exhaust port which is connected to the nozzles of the air turbine. Exhaust air drives the turbine attached to the rotary valve. The valve directs the air supply first to one side and then to the other side of the piston so that the cycle is completed and automatically repeated. The pulsating energy is transmitted to the file.

The weight of the tool is 1½ lb. and the length is 7 inches.

Chicago Centrifugal Pumps

DIRECT-CONNECTED horizontal centrifugal pumps, known as the N-Type, have been announced by the Chicago Pump Company, 2336 Wolfram St., Chicago, Ill. They may be used for hot and cold water and brine circulation, booster service, water systems, and other industrial applications.

Units are mounted on three feet, two of which are placed under the pump to support pipe, thereby relieving the motor shaft and frame of excessive stress and strain. Impellers are made of bronze, keyed to the motor shaft and held in place by a nut and locknut. The motor shaft is stainless steel and is extended to accommodate the impeller. The pump casing is semi-steel.



A suction lift of 15 ft. is guaranteed when the pump is furnished with a water seal.

Long Drawing-Board Top

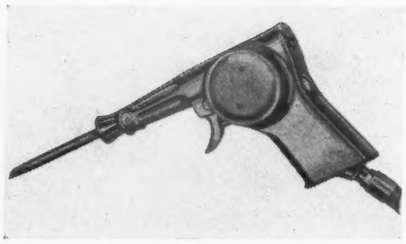
THE "No-Ink" drawing board top, said to eliminate the necessity for inking drawings, has been announced by the W. H. Long Company, 420 North Clark St., Chicago, Ill. This material is of white composition and is washable with soap and water.

In use, regular drawing paper is attached directly to this surface and a hard pencil is used. All lines are drawn with a double stroke and with a slight pressure on the pencil. The pressure of the first stroke ridges the paper and the back stroke fills that valley with lead. Because of the resiliency of the board, the indentations in the surface, made by the pressure of drawing tools, disappear immediately.

The board top is ⅛ in. thick and comes in sheets which can be glued or fastened to old drawing boards.

Madison-Kipp Air Chipper

AN air-driven chipping tool, known as the Kipp Air Chipper, has been developed by the Madison-Kipp Corporation, Madison, Wis. It is air driven and operates at pressures of 60 to 100 lb. Over 6,000 blows per min. are delivered to the chisel through a turbine-valve-hammer mechanism. The intensity



of the chisel strokes or blows is regulated by the pressure the operator exerts against the chisel and by the position of the trigger valve. Lighter cuts may be taken by less pressure on the handle by the operator and by less pressure on the trigger valve.

As shown in the illustration, the tool has a body or housing pistol shaped. Chisels are inserted into the barrel and held there by means of a spring clamp. Chisel shanks are pentagon shaped and may be inserted with any of the five sides in an upward position. The chipper itself will operate in any position, giving the operator freedom of action for clearance and convenience. Chisels in a variety of shapes are available to meet the needs of a wide range of work.

Monitor Slip Switch

A SLIP switch for breaking a.c. motors has been introduced by the Monitor Controller Company, Baltimore, Md. This device is designed for use with a.c. controllers where reverse-torque or plug-reverse braking is employed, and where motors coming to rest can be allowed to start in the reverse direction before being disconnected.

The switch is attached to the motor end bell and operated by direct connection to the end of the motor shaft. The contact switch is operated by an arm connected to a friction ring mounted on an extension of the motor shaft. The friction exerts enough pressure to hold the contacts closed. Motion in the opposite direction opens the contacts. By this construction the motor is disconnected the moment it comes to rest and starts to reverse.

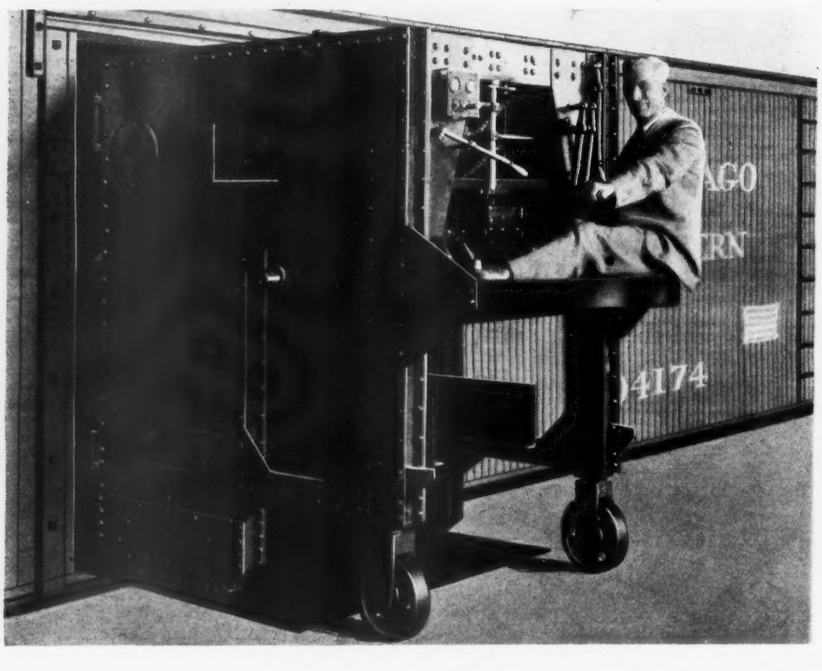
Signode Edwards Loading Machine

THE Edwards loading machine now being distributed by the Signode Steel Strapping Company, 2600 North Western Ave., Chicago, Ill., is designed to lift and carry bundles of sheet metal in and out of box cars. Two 20-in. bundles of sheets, one on top of the other, may be handled at one time.

The machine is a gasoline-powered trackless crane fabricated from structural steel which straddles the load. The power unit is mounted at the top leaving the space between the legs clear to provide a 44-in. lift for the 10-ton hoist. Most of the weight is carried on two caterpillar treads made from links of special steel alloy. The other end of the machine is carried on wheels.

A steering bar varies the relative speed of the two caterpillar treads and also steers the wheels.

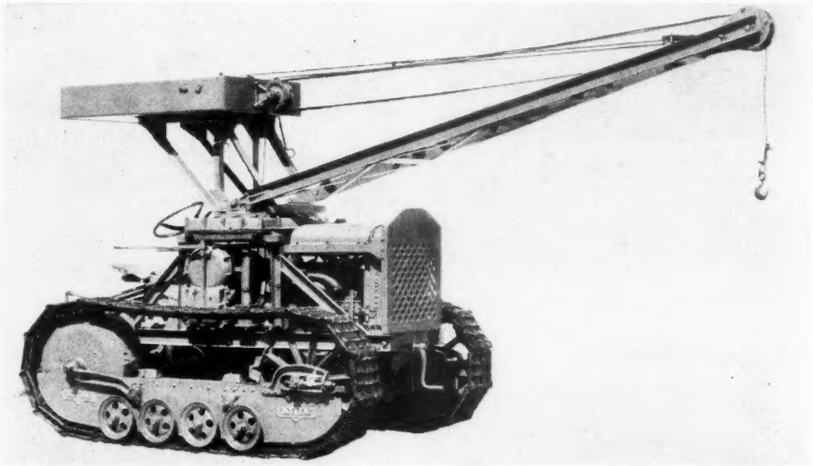
Motive power is supplied by a 4-cyl. Continental gasoline engine which also provides power for the hoisting mechanism and for clamping the carrier hooks under the bundle.



Trackson Model GU Crawler

THE Hughes-Keenan Roustabout crane manufactured by the Hughes-Keenan Company, Mansfield, Ohio, has been adapted to the Model GU Trackson Allis-Chalmers industrial crawler tractor, announces the Trackson Company, 1320 South First St., Milwaukee, Wis. Some of the suggested uses for this equipment in and around industrial plants includes the handling of boxes and bales, heavy castings, flasks, patterns, and other unwieldy loads.

The boom of the crane is full-revolving, swinging in all directions on a ball-bearing turntable, and is effective at all points, the counterweight box also being mounted on the turntable. The boom can be raised and lowered by power, enabling the unit to go through doorways. Loads can also be raised or lowered without moving the boom. The load is lifted by a cable wrapped on a drum which is independent of the cables that hold the boom in place.



Matthews Fuse Cutouts

WET-PROCESS, porcelain-housed cutouts in four sizes, numbered 550, 650, 850 and 950, have been announced by the W. N. Matthews Corporation, 3722 Forest Park Blvd., St. Louis, Mo. These devices are of the expulsion type with the cartridge mounted on the door, and are for use principally on distribution transformers, branch lines and underground laterals.

Four entrance wire holes which permit either right or left side or right and left side connection are partially surrounded by an ear to provide greater leakage surface and to prevent rain from entering the housing. Doors are of Bakelite and are provided with a large pulling ring.

Contacts are of the flat-surface pressure type. The male portions are made of brass and form a wiped contact with the female portions. The female portions are of busbar copper. Hangers are made of hot-dipped, galvanized mild steel and are adjustable to standard sizes of cross arms.

EDITOR'S NOTE: Through error, an illustration of the cutouts described above was used with a description of Matthews Solderless Service Connectors in the January issue. The January announcement should be disregarded.

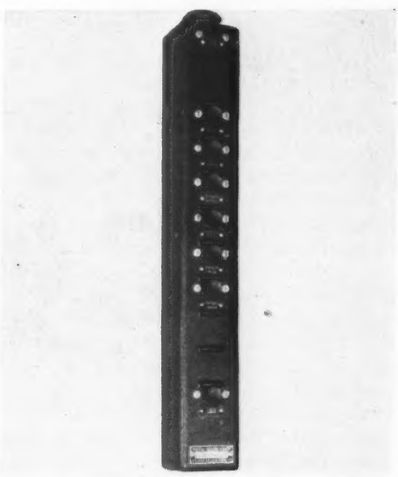
Johns-Manville Packing

PACKING, known as J-M No. 350 Semi-Metallic, designed for use against steam, air, water, and oil on centrifugal rods at high or low pressures and at temperatures up to 500 deg. F., has been announced by the Johns-Manville Corporation, 292 Madison Ave., New York, N. Y. The material is plaited square from a combination of asbestos fiber and non-abrasive metal and is thoroughly lubricated and graphited.

The packing can be used in reciprocating rods and plungers, either alone or in combination with other packings, and is available in coil and ring form in sizes from ¼ in. up.

General Electric Pushbutton Crane Control

PENDANT-TYPE push buttons for controlling small, floor-operated cranes have been announced by the General Electric Company, Schenectady, N. Y. These units are designed to supersede the present rope and chain types of control, with the advantages of greater safety to the operator, a saving in time and less aisle space required on the factory floor.



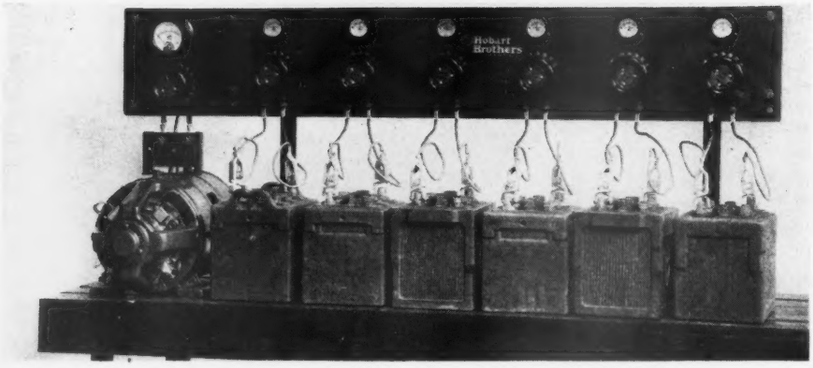
The pushbutton station is 20¼ in. long, 2⅜ in. wide and 2$\frac{9}{16}$ in. deep less the projection of the buttons. The box is cast aluminum.

Hobart Battery-Charging Unit

HOBART BROTHERS COMPANY, Troy, Ohio, announces the "Convar" battery charging unit, a constant-potential m.g. set with "Vary Rate" control panel.

The generator is available in two sizes, the smaller of which will charge 6 normal batteries in 8 hr., 12 in 16 hr., 18 in 24 hr., and 36 in 48 hr. The larger size will handle double this number in the same length of time. The smaller size comes with panel, instruments and connections for 6 batteries at a time, while the larger provides for 12 batteries at a time.

The generator is close-coupled to the bus bars in the panel which, it is

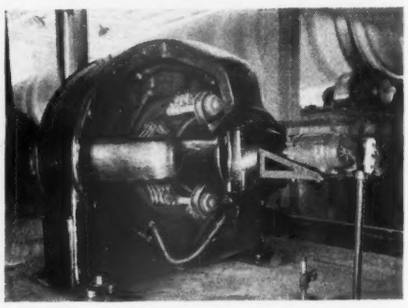


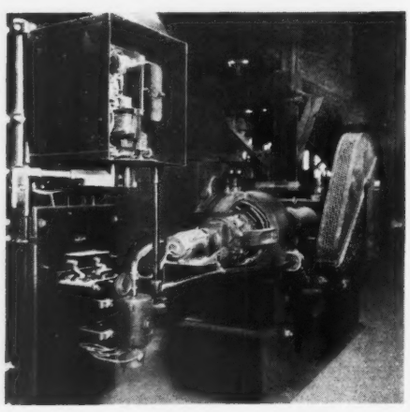
claimed increases the efficiency by reducing the length of cable through which the charging current must travel. Generator voltmeter and field rheostat are mounted, together with the rate control instruments (a separate ammeter and rheostat for each battery connection) in an ebony asbestos board.

General Electric Speed Control System

EXACT agreement of operating speeds of two or more non-synchronous electric motors can now be maintained by means of a control system announced by the General Electric Company, Schenectady, N. Y. This system, in which "selsyns" (small self-synchronizing motors) play a fundamental part, is expected to be of advantage in industrial applications where synchronous operation of different machines or devices is essential. For instance, in a cement plant the feed of raw material must be exactly proportional to the speed of the kiln.

Selsyn generators are mechanically connected to the shafts of the motors driving the kiln and feeding mechanism. When conditions are normal the two generators are in synchronism. A selsyn differential motor has its stator electrically connected to one generator and its rotor to the other. When the generators are in synchronism the selsyn motor has no tendency to rotate. Any deviation in speeds between the two generators will cause the differential motor to rotate forward or reverse, depending on which generator is ahead, the motor speed being equal to the difference between generator speeds. The selsyn motor is geared to a cam that actuates a carbon pile resistor which is connected in the field circuit of the feed motor. Resistance of the carbon pile changes with pressure and thus changes the speed of the feed motor and again establishes a balanced condition.





Chisholm-Moore Electric Chain Hoist

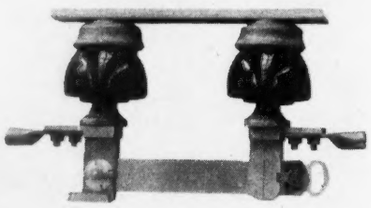
TO handle bulky loads such as bar steel, lumber, paper rolls, automobile bodies, and so on, the Chisholm-Moore Hoist Corporation, Tonawanda, N. Y., introduces the "Cyclone" Twin-Hook electric chain hoist. Capacities range from ½ to 3 tons.

Distance between load chains varies from 3 to 15 ft., depending upon the particular handling job. When desired, containers are attached to the hoist frame for holding the slack chain and keeping it from touching the object lifted. Safety limit switches stop the operation of the hoist when the hooks reach either the highest or the lowest position. A magnetic brake prevents drifting of the load.

Each hoist mechanism is equipped with eight ball bearings and four self-retaining roller bearings, and operates in a grease bath in a dust-proof, oil-tight frame. The controller is of the single-speed, drum type, and is operated by a pendant rope. Electric-welded "Inswell" load chain is used.

Delta-Star Disconnecting Switches

A LINE of outdoor, single-pole, hook-stick-operated 4.5-kv. 300-amp. disconnecting switches for inverted mounting has been announced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Illinois.

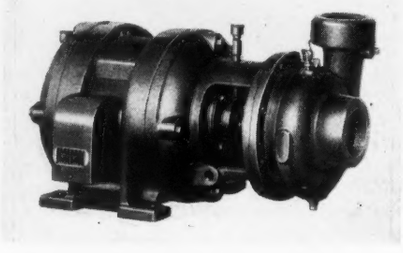


A feature of this design is the use of a positive safety lock on the blade and contact clip and a holding lock on the hinge end which secures the blade firmly in the open position.

Allis-Chalmers "SSU" Pumping Units

ALLIS-CHALMERS MANUFACTURING COMPANY, Milwaukee, Wis., announces the addition of three sizes to its line of "SSU" centrifugal pumping units of single-shaft, two-bearing design, which now includes ratings from 30 to 500 g.p.m. for heads under 100 ft. The adoption of total inclosure of motor housings on the pump end of these units and the use of totally inclosed, fan-cooled motors permits their use for severe service conditions.

Some suggested applications of these pumps are: water supply; circulation of water, oil or brine for heating or cooling systems; air conditioning, and auxilliary service to power equipment for cooling water seals.



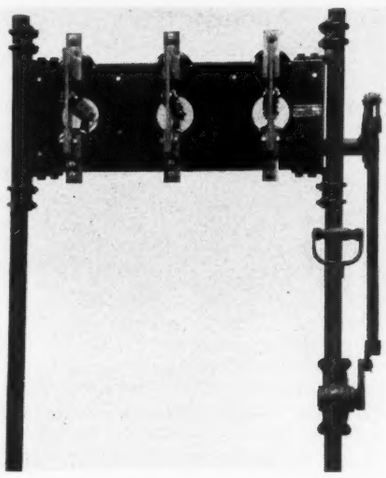
Baldwin-Southwark Corporation Succeeds Southwark Foundry & Machine Company

ACCORDING to a recent announcement, the Baldwin-Southwark Corporation, Eddystone, Pa., is now carrying on the entire business formerly done in the name of the Southwark Foundry and Machine Company.

Correct post office address is Paschall Station, Philadelphia, Pa. Its principal lines are hydraulic machinery, power tools, testing equipment, and special machinery.

Delta-Star Switching Unit

A SELF-CONTAINED, gang-operated switching unit for mounting on pipe framework has been announced by The Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill. A



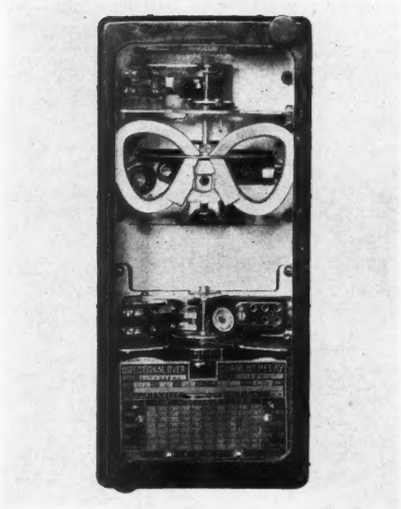
steel base carries the complete interlocking operating mechanism, controlled by a handle which can be located at any desired height from the floor. The base is drilled for mounting barriers.

Units are made for a wide range of voltage and current capacities, and are shipped fully assembled, ready for installation.

General Electric Directional Overcurrent Relay

ANNOUNCEMENT is made by the General Electric Company, Schenectady, N. Y., of a relay, designated Type IBC, for directional overcurrent protection against phase-to-phase and phase-to-ground faults in an electrical system. The relay and a power directional unit, both of the induction type, are housed in a rectangular case.

The power directional unit is supplied with single-throw contacts which

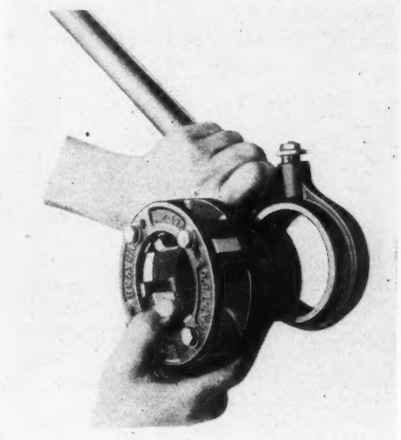


can short-circuit shading coils wound on the pole pieces of the overcurrent unit. The direction of power flow at the time of a fault thus determines whether the overcurrent unit is to be permitted to develop torque and operate or is to remain in the reset position regardless of any overcurrent that may be flowing. Contacts of the overcurrent unit are connected to the trip circuits of an oil circuit breaker.

Relay contacts are self-aligning, the stationary members being individually adjustable and the movable member, a silver disk, which provides different points of contact. When the relay has operated, a target indicator is visible from the front.

Borden Ratchet Die Stock

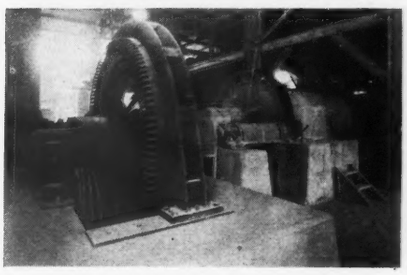
"BEAVER" No. 17 ratchet die stock, introduced by The Borden Company, Warren, Ohio, threads ½-, ¾-, 1-, 1¼-, 1½-, and 2-in. pipe, using separate heads for each size. Dies can be removed for sharpening or replaced with new dies. An extra-long handle gives necessary leverage for easy cutting.



Westinghouse Synchronous Motor

KNOWN as the Simplex, the salient-pole synchronous motor introduced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., is said to have starting and accelerating characteristics similar to a wound-rotor induction motor. Both the motor and its controller are designed for operation in dusty locations.

The ordinary cage-type damper winding in the pole heads has been replaced by a phase-connected damper winding. Winding ends are brought out to slip rings, permitting the use of a variable,



external starting resistor such as that used with a wound-rotor induction motor. This resistor is automatically cut out, in steps, by the controller, and, when synchronous speed is approached, the d.c. excitation is applied and the motor synchronized.

Russell Electric Glue Pots

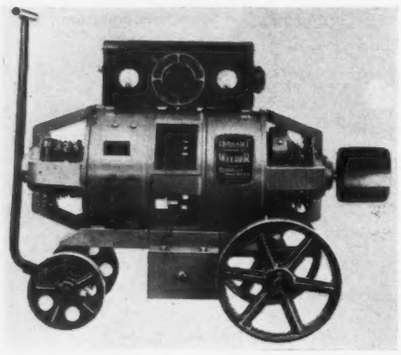
ELECTRICALLY welded boiler-plate shells and thermostats which operate direct from the glue chamber are features of the "Hold Heet" electric glue pots made by the Russell Electric Company, 340 West Huron St., Chi-

cago, Ill. The thermostat bar carries no current. It lies in contact against the copper bottom of the heating chamber and is actuated by the temperature of the glue itself.

Pots are made in 1-, 2-, 4-, and 8-quart sizes for 110 and 220 volts. A 6-ft. rubber cord with Bakelite connector and rubber attachment plug are standard equipment.

Hobart Welder

HOBART Brothers Company, Troy, Ohio, announce the "Constant Arc" welder with the Unitrol dial available with a shaft extension for stationary installations. The unit may be equipped with a pulley attachment for belt drive or a flexible coupling for



shaft drive. This arrangement makes it possible to use the outfit as an electric motor when not in use for welding.

When ordered for belt drive, equipment includes a standard, steel-core paper pulley, 8 in. in diameter with a 6-in. face, mounted directly on the extended generator shaft. When ordered for direct shaft connection an 8-in. flexible coupling is furnished in place of the pulley.

General Electric Weatherproof Cubicles for Automatic Switchgear

WEATHERPROOF housings for various types of automatic switchgear have been announced by the General Electric Company, Schenectady, N. Y. Standard switch-house doors, front and rear, each of which may be

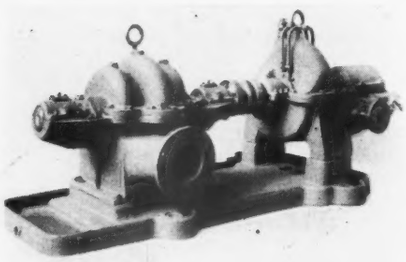
locked, afford access to both sides of the switchboard. Screened ventilators are placed in the sides and under the edge of the roof. Units are portable, being provided with lifting lugs on each side at the top. Leads for control wiring enter through the floor.

The cubicle is heated by elements attached to the sides; the temperature is regulated by a thermal relay mounted on the panel framework. A door switch at each end signals to the main operating headquarters when either door is opened.

Housings are 7 ft. 6 in. high, 9 ft. long, and 6 ft. wide. They are shipped completely assembled for installation.

Westinghouse Single-Stage Condensate Pumps

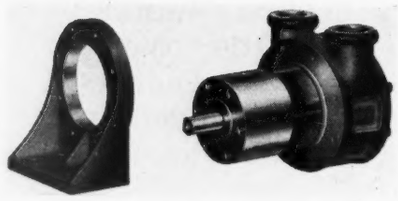
SINGLE-STAGE condensate pumps have been announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. These



pumps are used principally where low operating heads are encountered, multistage units being furnished for applications where high pumping heads prevail. They are of the horizontal, volute, centrifugal type employing a double-section impeller with opposed inlets.

Tuthill CP Oil Pumps

BALL bearing Model CP oil pumps, primarily intended for hydraulic applications, but also suitable for handling all lubricating liquids, have been announced by the Tuthill Pump Com-



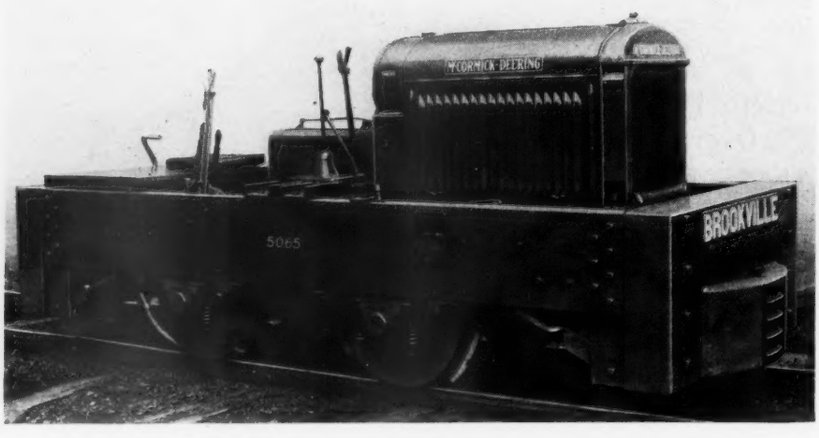
pany, 131 West 63rd St., Chicago, Ill. The pumps are of the rotary, internal-gear, positive-delivery type with an improved stuffing box and are built for pressures up to 200 lb. per square inch.

Four sizes are available, ranging in capacity from 2 g.p.m. at 300 r.p.m. to 40 g.p.m. at 1,200 r.p.m. Construction features include ball bearings to absorb thrust and radial loads of the rotor, an improved standard mounting design, primarily arranged for end mounting but with an optional bracket for users desiring foot-type mounting.

Brookville Industrial Locomotives

INDUSTRIAL haulage locomotives with McCormick-Deering power units, in 8- and 10-ton sizes, have been announced by The Brookville Locomotive Company, Brookville, Pa. These locomotives, known as BMD-8 and BMD-10, are equipped with McCormick-Deering Model "300" gasoline units, a five-speed transmission and a clutch made by the International Harvester Company. This equipment is installed in the chassis without alteration. An inclosed gear reverse makes all five speeds of the transmission available in either direction. Dual spring journals and wide wheel faces are standard equipment.

Locomotives are available in any gage from 22 to 56½ in. or wider, and are equipped with either four-pocket link and pin-type couplers or with MCB couplers for use with standard freight cars. Wheelbase, overall height and other dimensions are variable, within limits, to suit particular requirements.

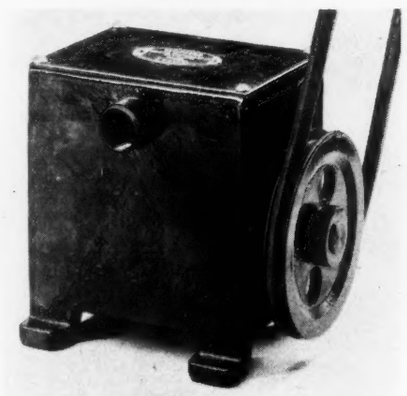


Monitor "Lotrip" Switch

ANNOUNCEMENT is made by the Monitor Controller Company, Baltimore, Md., of a "Lotrip" switch for reverse-torque or plug-reverse braking of a.c. motors. In operation, this switch automatically disconnects the motor from the line just before it comes to rest.

The device consists of a contact switch in the coil circuit of the brake-line contactor. The switch is held closed by pressure from an arm mounted on a friction ring and carried by a rotating shaft driven by the motor to be controlled.

Normally, the friction ring slips and the arm exerts no pressure on the contact arm but when the speed of rotation increases to definite low value, a quick-action centrifugal regulator throws a clutch that applies friction to the ring and exerts the pressure necessary to



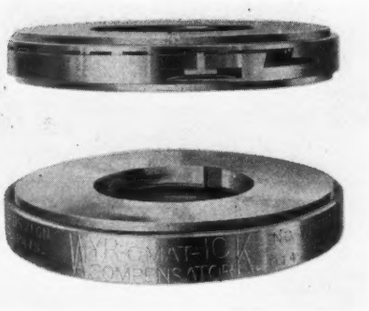
close the brake contactor circuit. This contact remains closed until the brake circuit comes into action and the motor slows down to the critical trip speed, when the centrifugal regulator snaps back to normal position and the brake circuit is opened, disconnecting the motor from the line.

Mechanism is inclosed in a cast-iron case provided with mounting feet and a drive pulley which is belted to the same shaft that is connected to the motor.

The switch, however, can be used for braking in either direction or in both directions by changing the switch arms.

Wyrick "Wyr-omat-ick" Compensators

WYRICK Engineering Company, Wyandotte, Mich., announces the "Wyr-omat-ick" Compensator, a device for automatically maintaining bearing adjustments to specified limits of clearance. The major parts are two mating, helical, cam-faced members, one slotted and one smooth, which, when placed together, will increase or decrease their joint cross-sectional dimension if rotated in opposite directions. These two parts serve the space-filling requirements necessary when wear occurs. A spring attached to both cams, provides the power to rotate the cammed members whenever this action is required.



The expanders are two hardened steel balls backed by expansion springs urging them outward to exert a pressure against the inner surface of the slotted cam when the cams are placed face to face. This action insures separation of the two cam faces, when through wear or other factors increased space occurs.

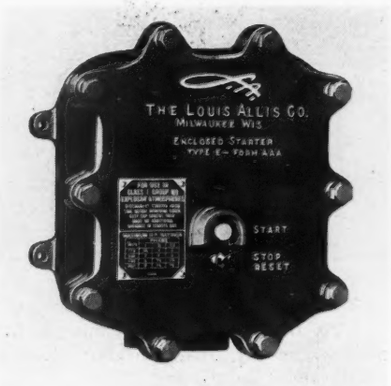
A T-shaped control pin is ground to project beyond the face of the smooth cam in which it is assembled a distance equal to the maximum clearance required. The pin projects into one of the slots of the slotted cam and engages one of the ribs of the latter, preventing rotation until sufficient space is allowed to permit the cam faces to separate a distance equal to the protruding portion of the control pin.

A locking seal holds the cams in their reduced dimension until the device is assembled in working position between two spaced parts.

Louis Allis "Explosion-Proof" Motor Starter

AN air-break, "explosion-proof" motor starter, known as Type E, Form AAA, has been announced by The Louis Allis Company, Milwaukee, Wis. It is built to withstand the force, and prevent the escape of flames from any explosion likely to occur inside the apparatus due to grounds, burn-outs and so forth. Essentially, the starter consists of the usual across-the-line, air-break magnetic contactor with overload and under-voltage protection.

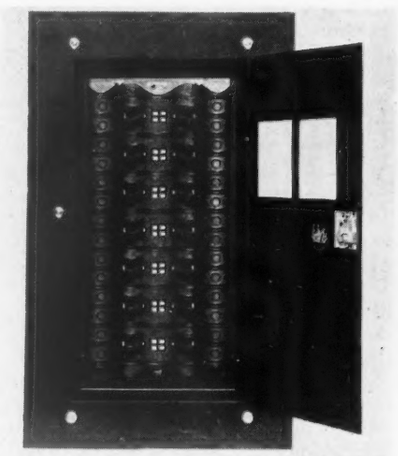
The cast-iron inclosing case is equipped with a cover held by ten cap screws.



Bull Dog Lighting Panels

BAKELITE lighting panels, known as the Superba line, have been introduced by the Bull Dog Electric Products Company 7610 Jos. Campau Ave., Detroit, Mich. Design and construction features permit change of circuit connections for both voltage and phase without removing the door and trim or disturbing the wiring connections.

Either plug or cartridge fuse connections and single- or double-pole switches may be interchanged without removing the door and trim. Cartridge fuse type panels incorporate a fuse ejector.

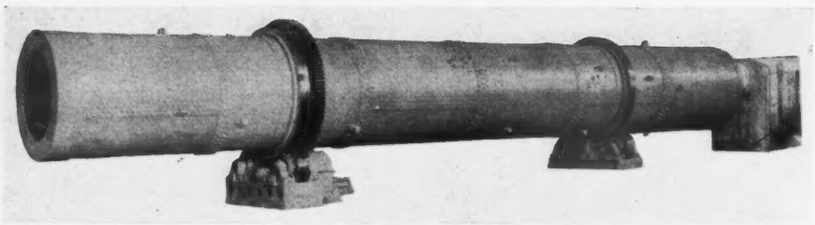


The panel itself is of the dead-front type. Individual doors over fuse compartments are an integral part of the face plates.

If desired, Bakelite covers can be furnished in a variety of colors to match a background color scheme.

Linde Service Facilities

ANNOUNCEMENT has been made that those units of Union Carbide and Carbon Corporation whose products are used, in the main, for oxy-acetylene welding and cutting are to market their products through The Linde Air Products Company. It is now possible, therefore, to secure Linde Oxygen, Union Carbide, Prest-O-Lite Dissolved Acetylene, and Oxweld, Prest-O-Weld, and Purox apparatus and supplies through this one company.



Struthers-Wells Rotary Dryers

ROTARY dryers and kilns in sizes ranging from 2 ft. 6 in. to 10 ft. in diameter and in lengths from 20 to 200 ft. have been announced by the Struthers-Wells Company, Warren, Pa. These units are suitable for use in industrial plants requiring the drying and calcining of granular material in bulk. They are equipped with roller bearings and may be supplied for pulverized coal, gas, or oil firing.

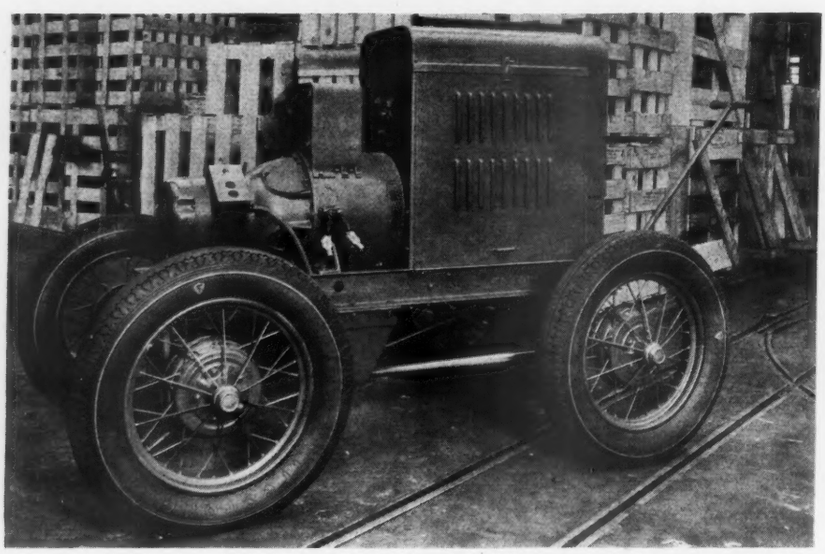
The shell consists of heavy plate sections riveted or welded together and butt-strapped to prevent warping or distortion under load or changes in temperature.

Kilns are equipped with a lining of refractory material. Shells may be provided with both a lined and an unlined section, so that a drying and a calcining operation can be performed in the same shell.

The weight of the shell is carried on two tires or riding rings of rolled steel, the 7-ft. size having an 8-in. face. Tires are mounted so that expansion of the shell will not affect their relation with the trunnion rollers. Two trunnion rollers, 28 in. in diameter, with 9-in. faces, are provided for each tire. The rollers are mounted on a common base of heavy, cast semi-steel, and each roller is mounted on a dead shaft carried in pedestals. Timken bearings are mounted in the roller hub. Pedestals can be adjusted in four directions to compensate for any inaccuracies in leveling during installation.

Westinghouse Portable Welders

PORTABLE welding units, particularly adaptable for localities beyond the reach of electric power lines, have been announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. These machines are equipped with pneumatic-tired wheels and an oversize exciter for auxiliary power purposes, and are available



in ratings of 200, 300, 400 amp. and larger.

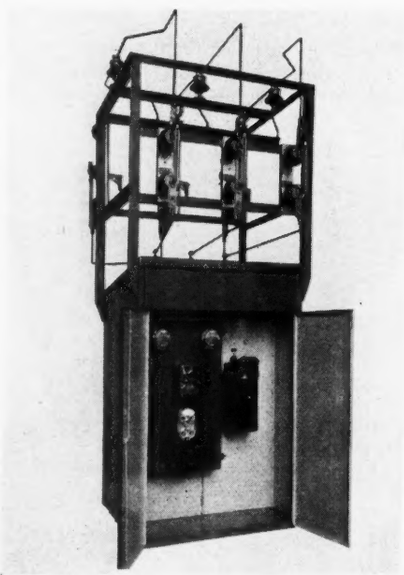
The machine illustrated is the standard stationary welder mounted on pneumatic-tired wheels, and consists of a 200-amp., single-operator generator, together with a 1½-kw., 125-volt exciter driven by a 4-cyl. gasoline engine. The welding generator is of single-bearing construction with the frame fitted directly into the engine flywheel housing. The engine has a standard rating of 18.22 hp., and develops 24 brake hp. at 1,450 r.p.m., welding generator speed.

Two outlet receptacles and a line switch are provided for connection to small tools, lights, and so on.

General Electric Outdoor Switch Houses

OUTDOOR switch houses with open-type superstructures have been developed by the General Electric Company, Schenectady, N. Y., for use on circuits up to 15,000 volts. Disconnecting switches are mounted on the superstructure for isolating manual or automatic switchgear which may be installed in the switch house.

Supports are used for the strain insulators, by means of which live wires are brought to the structure, and suitable connections are made to the disconnecting switches without bringing undue strain on any part of these devices.



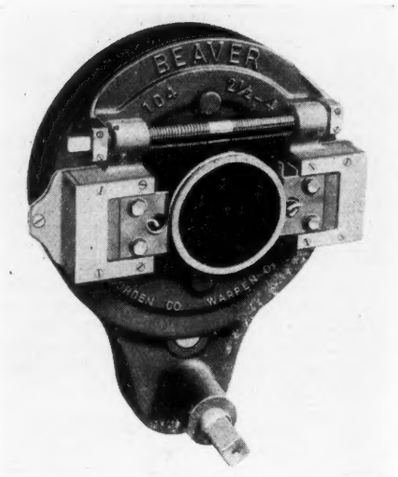
Switches used in the superstructure are standard outdoor devices with all parts designed to resist the harmful effects of the elements. The superstructure framework is fabricated from hot-dip galvanized iron.

Trumbull Division Changes Name

THE Trumbull Electric Manufacturing Company, Plainville, Conn., announces that the name of its western division, the A. G. Electric Manufacturing Company, will be changed to the Trumbull Electric Manufacturing Company, Pacific Division. Manufacturing plants are located at Seattle, Wash., and Los Angeles, California.

Borden Beaver Pipe Cutter

A SQUARE-END pipe cutter, known as the No. 104 Beaver, for 2½- to 4-in. pipe, has been introduced by The Borden Company, Warren, Ohio.



The tool is made of nickel semi-steel and is available in three styles; Standard, Extra-Heavy, and Double Extra-Heavy. The cutter is centered on the pipe by means of self-centering V blocks. The wrench used in centering is also used to compress the spring-fed knife blocks. Knives have a safety guide ahead of the cutting edge.

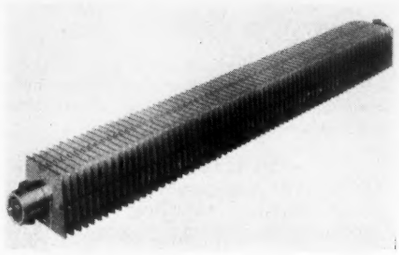
The stationary driving pinion which is in front may be hand or power driven.

American Hydro-Thermal Grids

HYDRO-THERMAL grids for use in place of coils in mechanical refrigerating systems are announced by the American Engineering Company, 2666 Cumberland St., Philadelphia, Pa. A grid consists of an outer tube with fins, inclosing an inner tube. The fins provide a heat-absorbing area in a small space, while the tube-within-a-tube construction spreads out the refrigerant in a thin layer in contact with the large area of the outer tube. Refrigerant enters at one end of the tube; the heat-laden gas escapes at the other end. The inner tube can be filled with brine when a hold-over is desired.

Both tubes and fins are of steel. Fins are applied under hydraulic pressure, producing a close frictional bond between the fin and tube for rapid heat transfer. The entire grid is hot galvanized and is tested to 300-lb. pressure.

Units are made with fins of three sizes and in a number of lengths.



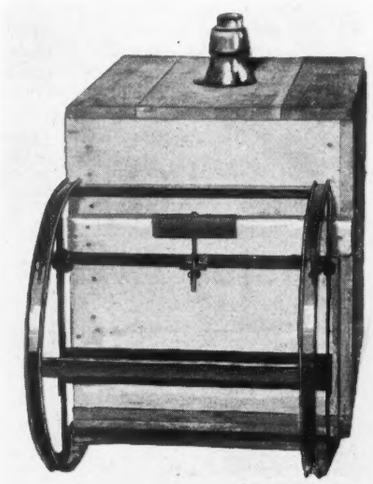
Stewart "Inso" Lath

KNOWN as "Inso" Lath, the plaster base introduced by The Stewart Inso Board Corporation, St. Joseph, Mo., provides for free expansion by means of beveled edges and ends, so arranged that the spaces cannot be filled with plaster. Nailing slots are provided which permit slight movement without binding, eliminating bulges and warping.

The material, it is claimed, is sound proof and provides insulation against heat and cold. It is made in sheets 18 x 48 inches.

Schwenk Safety Clamp for Carboy Tilter

AN improved safety clamp has been added to the carboy tilter made by the Schwenk Safety Device Corporation, 70 East 45th St., New York, N. Y. The device is a grip designed to fasten



the bow-shaped elements to the cleat of the carboy box and prevent slipping or sliding. It is adjustable and will fit the cleats on all sizes of carboy boxes. The clamp is fastened by three wing nuts.

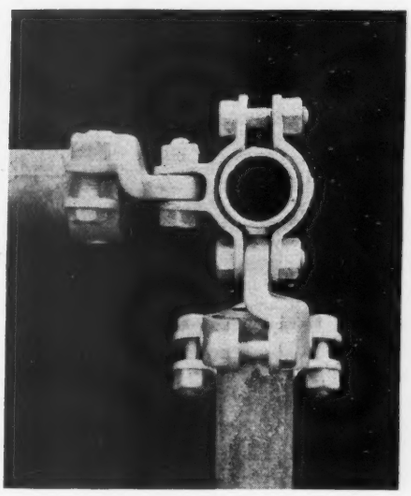
Bauer & Black Cotton Picker

ABSORBENT cotton in a cylindrical container known as the "Cotton Picker" is now being marketed by Bauer & Black, Division of the Kendall Company, 2500 South Dearborn St., Chicago, Ill. The cotton is coiled in the box in a loosely wound rope and emerges through an aperture in the top. The aperture is smaller than the diameter of the rope, to maintain its strength, and allows the cotton to come through smoothly without breaking. The cotton

expands as it emerges and may be plucked off as needed. A cover keeps the protruding tuft clean.

General Electric Pipe Fittings

GALVANIZED pipe fittings for 1¼-in. pipe have been announced by the General Electric Company, Schenectady, N. Y. The line consists of six different parts designed to permit the fabrication of a wide variety of pipe structures and framework. An important detail is a hinge joint. It is used because it breaks the continuity of a section and prevents bending stresses in the connection. It therefore permits development of the full strength of the pipe within the limits of deflection and



assures a connection equal in strength to the shearing value of the bolt.

Fittings are of certified malleable iron, hot-dip galvanized. Surfaces that clamp against the pipes are V-shaped and are ribbed to prevent slippage. Struts or bracing members are connected through a single bolt which acts as a hinge.

TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog described, as given in these columns.

* * *

(33) PUMPS — Bulletin 126, 24 pages, non-clogging, open-shaft pumps for sewage handling and drainage in industrial plants.—Chicago Pump Company, 2336 Wolfram St., Chicago, Ill.

(34) METERS — Circular 1753-B, 16 pages, "Registers of Revenue," watthour and demand meters.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(35) ELECTRICAL EQUIPMENT—Bulletin 2213, "Safety Circuits for Electrical Equipment." — Crouse-Hinds Company, Syracuse, N. Y.

(36) STEEL TREATING—Bulletin GEB-73, 76 pages, heat treatment of steel in G-E standard electric furnaces.—General Electric Company, Schenectady, N. Y.

(37) POWER TRANSMISSION — Bulletin 1267, 24 pages, specifications of sprocket wheels carried in stock.—Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill.

(38) AIR CONDITIONING EQUIPMENT—Bulletin 378, 5 pages, "Filticooler," for washing, filtering and cooling air.—B. F. Sturtevant Company, Hyde Park, Boston, Mass.

(39) POWER TRANSMISSION — "Handbook of Variable-Speed Control," 72 pages, complete engineering data on Reeves transmissions and general information on variable-speed control.—Reeves Pulley Company, Columbus, Ind.

(40) ENGINEERING SERVICE — Bulletin 17, 24 pages, a description of the engineering and consulting service rendered by this company.—E. Y. Sayer Engineering Corporation, 152 West 42 St., New York, N. Y.

(41) PIPE LINES — Bulletin 510, 52 pages, "The New Way of Designing and Building Gas Lines with Smithwelded Pipe."—A. O. Smith Corporation, Milwaukee, Wis.

(42) STEAM ENGINES — Bulletin 304, 24 pages, vertical steam engines for stationary and marine service.—Troy Engine & Machine Company, Troy, Pa.

(43) PUMPS—Bulletin 128, 28 pages, heavy duty, screenless, inclosed-shaft, non-clogging pumps. — Chicago Pump Company, 2336 Wolfram St., Chicago, Ill.

(44) ELECTROPLATING — Booklet, 36 pages, "Electroplating Aluminum," a detailed description of this process and useful data and tables of materials and procedure.—Aluminum Company of America, Pittsburgh, Pa.

(45) POWER TRANSMISSION — Catalog 135, 32 pages, small, heavy-duty, worm-gear speed reducers.—D. O. James Manufacturing Company, 1120 West Monroe St., Chicago, Ill.

(46) SAFETY PANEL—Bulletin, convertible safety panels for power and light distribution, built in all ratings up 575 volts. —Square D Company, Detroit, Mich.

(47) INDUSTRIAL HEATING — Catalog C-247, 100 pages, operating data, charts, tables and installation photographs in addition to specifications and illustrations of industrial heating equipment.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Coming Events

Fifth Midwest Engineering and Power Exposition—Coliseum, Chicago, Feb. 10 to 13, 1931. Managers, Midwest Engineering Exposition, Inc., 308 W. Washington St., Chicago, Ill.

Second National Western Metal Congress and Exposition—Civic Auditorium, San Francisco, Calif., Feb. 16-20, 1931. Under auspices of A.S.S.T. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

Second National Industrial Congress Featuring Management, Maintenance and Materials Handling—Public Auditorium, Cleveland, Ohio, April 13 to 18, 1931, inc. In conjunction, Second National Industrial Equipment Exposition. Concerning technical sessions address P. T. Wetter, American Society of Mechanical Engineers, 29 West 39th St., New York City. Exposition under management Midwestern Engineering Exposition. 308 West Washington St., Chicago, Ill.

National Fire Protection Association—35th annual meeting, Toronto, Can., May 11 to 17, 1931. Association headquarters, 60 Batterymarch St., Boston, Mass.

National Electric Light Association—54th convention and exhibition, Municipal Auditorium, Atlantic City, N. J., June 8 to 12, 1931. Frank H. Gale, Secretary-Treasurer, 420 Lexington Ave., New York, N. Y.

Association of Iron and Steel Electrical Engineers—Iron and Steel Exposition, Cleveland Public Auditorium Annex, Cleveland, Ohio, June 14-15, 1931. Managing Director, John F. Kelly, Empire Bldg., Pittsburgh, Pa.

(48) POWER TRANSMISSION — Bulletin 101, 10 pages, "Wyr-omat-ick" Compensator, a device for maintaining constant clearance in bearings.—Wyrick Engineering Company, Wyandotte, Mich.

(49) WIRE ROPE—"Wire Engineering," a monthly publication covering engineering, technical and news articles on wire rope, welding wire, and wires and cables. —John A. Roebling's Sons Company, Trenton, N. J.

(50) POWER TRANSMISSION—Data Book and Catalog, 80 pages, description and illustrations of the Hygrade line of worm-gear speed reducers.—Foote Bros. Gear and Machine Company, 111 North Canal St., Chicago, Ill.

(51) FACTORY AND OFFICE EQUIPMENT —Catalog M-S, 30 pages, angle-steel and sheet-metal equipment for factory, shop and office.—Angle Steel Stool Company, Plainwell, Mich.

(52) GENERATORS — Bulletin 602, 24 pages, bracket- and engine-type generators for a.c. and d.c. service.—Troy Engine & Machine Company, Troy, Pa.

(53) ELECTRICAL EQUIPMENT—Bulletin, 4 pages, "Heating in Switches and Panelboards" by J. G. Jackson, Director of Engineering.—Square D Company, Detroit, Mich.

(54) WATTHOUR METERS — N.E.L.A. publication 16, 4 pages, "Watthour Meter Lubrication," a report of the meter committee, Engineering National Section. — National Electric Light Association, 420 Lexington Ave., New York, N. Y.

(55) WIRES AND CABLES—Bulletin, 16 pages, "Alectral" insulated aluminum wires and cables and necessary fittings.— General Cable Corporation, 420 Lexington Ave., New York, N. Y.

(56) POWER TRANSMISSION—Catalog 56, 160 pages, standard stock gears.— Charles Bond Company, 617 Arch St., Philadelphia, Pa.

(57) SPEED CONTROL—Bulletin 1151, 12 pages, "Rossman System of Adjustable Speed Control." — Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

(58) PAINTING—Folder, a description of the Vortex method of large-area interior painting.—The Vortex Manufacturing Company, 1978 West 77 St., Cleveland, Ohio.

(59) PANELBOARD—Bulletin, 14 pages, Superba lighting panels.—Bull Dog Electric Products Company, 7610 Jos. Campau Ave., Detroit, Mich.

(60) ANNEALING FURNACES—Circular, electric, bell-type annealing furnaces in both cylindrical and rectangular forms.— Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(61) MOTORS—Bulletin 200, unit-type induction motors, construction and specifications.—Ideal Electric and Manufacturing Company, Mansfield, Ohio.

(62) OIL BURNER—Bulletin 4H, R-S Model D1 low-pressure automatic oil burner for use with heat treating furnaces.—Ryan, Scully & Company, Philadelphia, Pa.

INDUSTRIAL ENGINEERING'S DATA SHEETS

Protection Against Fumes During Welding

Few fumes are harmful; good ventilation solves most problems that arise

GASES and fumes encountered in welding may be divided into two groups: Products of combustion resulting from blowpipe flames, preheating fires, etc.; fumes produced by certain metals and metallic compounds.

Nature of Effects

To understand the nature of the effects produced by flames and fires, it is necessary to review briefly some elementary facts of physiology. A continual supply of oxygen is necessary to support life, and the air that we breathe contains approximately 20 per cent oxygen and 80 per cent nitrogen by volume. In the body, this oxygen is converted into carbon dioxide which is discharged by the lungs in the form of the exhaled breath. Obviously the breathing of carbon dioxide would result in asphyxiation through lack of oxygen. Consequently, a high percentage of carbon dioxide is undesirable.

Oxygen is also necessary to support combustion in flames and fires. Practically all commercial fuels contain carbon, and carbon dioxide is one of the products of combustion when they are burned with free access of air. If, however, these fuels are burned with an insufficient amount of air, carbon monoxide, which is a violent poison, may be produced. Being odorless, it does not give any warning of its presence.

With these facts in mind it is possible to consider the effects of flames and fires in the welding shop.

In the first place, the gases from an oxy-acetylene blowpipe flame are harmless as they consist only of water vapor and carbon dioxide. If, however, a blowpipe is operated in a small unventilated room or in a confined space such as inside a tank for any length of time, the oxygen content of the confined atmosphere may be reduced to such an extent that the operator will feel uncomfortable and possibly drowsy. The obvious remedy is to supply a sufficient volume of fresh air whenever welding is done in a confined space.

Special Precautions

Whenever welders are working inside a tank special precautions should be taken. Ventilation should be provided by means of a compressed-air line or a line from a blower extending into the tank; also a helper should be on duty continuously outside the tank to act instantly in case of emergency. Oxygen from a cylinder should never be used for ventilation.

When the welding of a large casting, that has been preheated in a charcoal fire, is completed, and the fire is choked off so that it will die out gradually, conditions are such that carbon monoxide will be formed. Fortunately, it is seldom necessary for the welders to remain near the casting as it cools in the dying fire and consequently they are not ordinarily exposed to the carbon monoxide. Whenever possible, temporary preheating furnaces should be built under a roof opening or a ventilator and permanent preheating furnaces should be provided with a hood.

Metallic Fumes

Lead and zinc are the only commercial metals that cause any trouble through the production of fumes during welding or cutting.

Although fumes from zinc oxides are not poisonous, welders should avoid inhaling them as continued exposure may produce discomfort or even nausea.

Lead is much more troublesome than zinc because lead compounds are cumulative poisons. That is, long continued exposure to even very minute quantities will eventually result in lead poisoning. Lead fumes are encountered to a certain extent in lead burning and in work on storage batteries, but adequate ventilation will afford sufficient protection.

Lead fumes may be encountered in dangerous quantities in oxy-acetylene cutting of iron or steel work that has been painted with a lead-base paint. Since the majority of industrial paints contain lead compounds, suitable precautions should be taken before starting to cut painted material. If a cutter is to work steadily for any length of time on painted material he should be obliged to wear a properly designed gas mask. The type best suited for welders and cutters is one that covers the nose and mouth but not the eyes so that standard welding goggles can be worn at the same time. This mask has a flexible breathing tube leading to a canister strapped to the body of the wearer. The contents of this canister can be varied so as to afford protection against different types of poisonous gases. Such a mask will give complete protection against lead fumes.

Courtesy Linde Air Products Company

INDUSTRIAL ENGINEERING'S DATA SHEETS

INDUSTRIAL LUBRICATION RECORD

Month .....

Company ..... Oiler's Name ..... Dept .....

Date	TIME REQUIRED FOR LUBRICATION									OIL			SOLID LUBRICANT		
	Start	Stop	Elapsed Time	Start	Stop	Elapsed Time	Start	Stop	Elapsed Time	Qts.	Qts.	Total	Lbs.	Lbs.	Total
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Total hours worked ..... & Rate per hour ..... — .....
Total quarts oil used ..... & Cost per quart ..... — .....
Total pounds solid lubricant ..... & Cost per pound ..... — .....
Lubrication Cost per month _____

Courtesy Alemite Corporation